AD-A168 462 UNDERWATER FACILITIES INSPECTIONS AND ASSESSMENTS AT NAVAL AMPHIBIOUS BAS..(U) BLAYLOCK-WILLIS AND ASSOCIATES SAN DIEGO CA NOV 84 1/2

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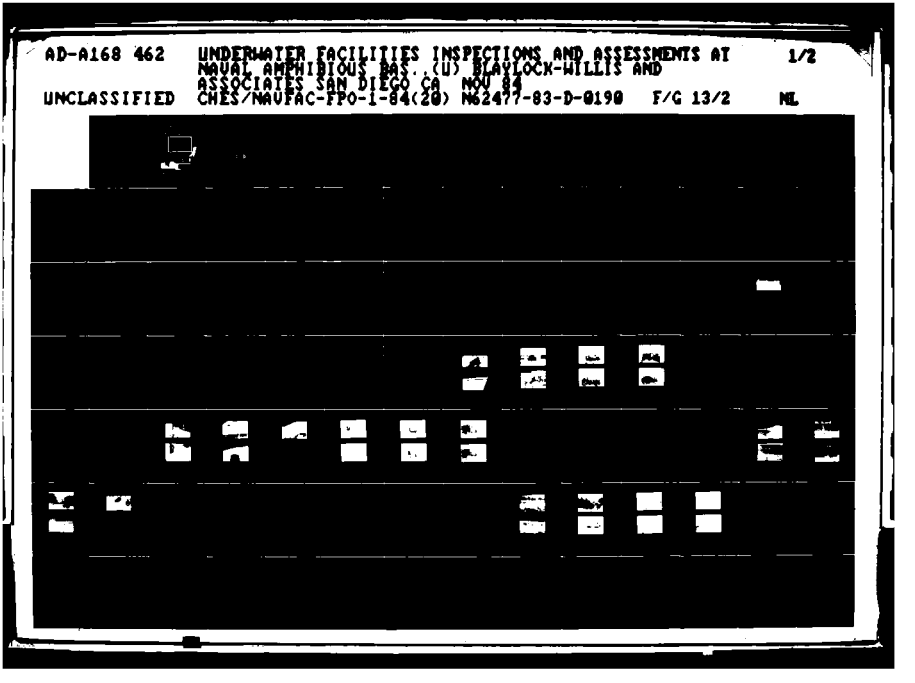

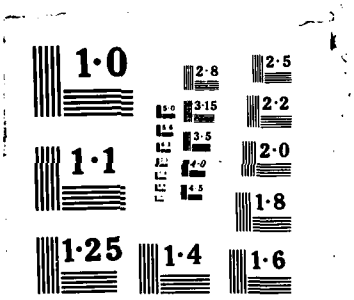
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UNDERWATER FACILITIES INSPECTIONS & ASSESSMENTS

(1)

NAVAL AMPHIBIOUS BASE CORONADO, CALIFORNIA

FPO-1-84(20) NOVEMBER 1984

OCEAN ENGINEERING AND CONSTRUCTION PROJECT OFFICE
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, D.C. 20374

UNDERWATER FACILITIES

INSPECTIONS

AND

ASSESSMENTS

AT

NAVAL AMPHIBIOUS BASE
CORONADO, CALIFORNIA

FPO-1-84(20) NOVEMBER 1984

"Original contains color plates: All DTIC reproductions will be in black and white"

PERFORMED FOR:

OCEAN ENGINEERING AND CONSTRUCTION PROJECT OFFICE
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, D. C. 20374

CONTRACT: N62477-83-D-0190-~~0002~~
TASK 2

BY: BLAYLOCK-WILLIS AND ASSOCIATES
1909 MC KEE STREET, SAN DIEGO, CALIFORNIA 92110

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FIELD	GROUP	SUB-GROUP	Underwater inspection, Naval Amphibious Base Coronado, Coronado, CA

19. ABSTRACT (Continue on reverse if necessary & identify by block number)
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general physical condition of the Bulkheads and piling of the Piers inspected. Each facility was inspected using non-destructive techniques. Typical and critical elements were photographed. The facilities inspected nd the recommendations regarding each of them are as follows: 1) Fuel Pier - The inspected portions of the Pier are in good structural condition. Minor surface sulphate damage to the piling has occurred but this is not significant. Evidence of past gunite repair to piles was noted. All gunite repairs are above water at low tide. Some of these piles are cracked and bleeding and will need further repair in the future. No damage considered to be presently of significant load reducing nature was observed. 2) Piers 1-15 and Bridge - The inspected portions of these facilities are considered to e in satisfactory structural condition. In general, the comments applying to Fuel Pier apply to Piers 1 through 15 and Bridge. 3) Mammal Pier - The supporting structural piles of the Mammal Pier are in excellent condition. However, considerable damage has been sustained by the pile cap beams. It appears that both the beams' stirrups and principal reinforcement are rusting resulting in cracking and spalling of the covering concrete. The inspection team was informed that the outer platform of the Pier had been overloaded and as a result the Pier had settled. The Pier had been built originally with a deck slope of 1/4 inch per foot to the south. The possibility is considered that this slope was misinterpreted as no evidence of pile subsidence was observed in this inspection. If further confirmation is desired, a simple level survey could be run on the Pier. 4) Bulkheads 1 and 2 - The Bulkheads are in generally good condition. There is some evidence of rusting horizontal reinforcement at the cap with accompanying cracking and spalling and there is some evidence of rusting of reinforcement in the wall panels. There is evidence of past gunite repair of this type of damage at various locations in the wall. It is recommended that continued attention be addressed to repair of severe spalling when it occurs. 5) Marina 1231 - At the time of this inspection, repair measures were under way to repair the deck of the floating piers and replace approximately 50 wooden piles with concrete elements. This is considered very much in order as most of the wooden piles have sustained significant damage and many are considered in bad condition.

The outer piles of the fixed access Pier have been covered with either concrete jackets or plastic wrapping. These covers do no extend to the mudline in all cases leaving bare wood exposed to borer attack. These exposed areas should be covered.

EXECUTIVE SUMMARY

An inspection was made of certain facilities at the Naval Amphibious Base, Coronado (San Diego), California during the period August 6 to August 10, 1984.

The principal object of the inspection was to provide that quality of inspection that would allow the engineer inspector/divers to assess the general physical condition of the Bulkheads and piling of the Piers inspected. Each facility was inspected using non-destructive techniques. Typical and critical elements were photographed. The facilities inspected and the recommendations regarding each of them are as follows:

1. Fuel Pier - The inspected portions of the Pier are in good structural condition. Minor surface sulphate damage to the piling has occurred but this is not significant. Evidence of past gunite repair to piles was noted. All gunite repairs are above water at low tide. Some of these piles are cracked and bleeding and will need further repair in the future. No damage considered to be presently of significant load reducing nature was observed.

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form of the Pier had been overloaded and as a result the Pier had settled. The Pier had been built originally with a deck slope of 1/4 inch per foot to the south. The possibility is considered that this slope was misinterpreted as no evidence of pile subsidence was observed in this inspection. If further confirmation is desired, a simple level survey could be run on the Pier.

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The outer piles of the fixed access Pier have been covered with either concrete jackets or plastic wrapping. These covers do not extend to the mudline in all cases leaving bare wood exposed to borer attack. These exposed areas should be covered.

NAVAL AMPHIBIOUS BASE

CORONADO, CALIFORNIA

EXECUTIVE SUMMARY TABLE

FACILITY	YEAR BUILT OR MODIFIED	NO. & TYPES OF PILE IN STRUCTURE	SIZE (AREA) FT²	SIZE (LENGTH) FT.	STRUCTURE	REC
Fuel Pier	1956	40 Concrete bearing	3670		16" Square conventionally reinforced concrete	Rein
Piers 1-15 & Bridge	1954	48 Concrete bearing	4560		16" Square conventionally reinforced concrete	Rein
Mammal Pier	1976	61 Concrete bearing	6458		14" Square P/S concrete	Repa crac post
Bulkheads 1 & 2	1951	Concrete sheet		4540	10" Thick conventionally reinforced precast concrete	Cont main spec
Marina 1231		Fixed pier - 34 Wood bearing	760		14" Dia. Wood	Insp repa and
		Fingers - 65 Wood guide		2070	14" Dia. Wood	
		- 43 Concrete guide			29-14" Round, C.R.	
					14-12" Square, C.R.	
		- 2 Steel guide			6" Dia. Steel pipe	

NAVAL AMPHIBIOUS BASE

CORONADO, CALIFORNIA

EXECUTIVE SUMMARY TABLE

PES OF PILE CTURE	SIZE (AREA) FT2	SIZE (LENGTH) FT.	STRUCTURE	RECOMMENDATIONS	TOTAL REPAIR COST $
ete bearing	3670		16" Square conventionally reinforced concrete	Reinspect in 6 years.	
ete bearing	4560		16" Square conventionally reinforced concrete	Reinspect in 6 years.	
ete bearing	6458		14" Square P/S concrete	Repair deck and beam cracking. Conduct post repair inspection.	
sheet		4540	10" Thick conventionally reinforced precast concrete	Continued normal maintenance. Reinspect in 6 years.	
er - 34 Wood	760		14" Dia. Wood	Inspect when present repairs are completed and each 3 years thereafter.	
- 65 Wood guide		2070	14" Dia. Wood		
- 43 Concrete guide			29-14" Round, C.R.		
			14-12" Square, C.R.		
- 2 Steel guide			6" Dia. Steel pipe		

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SECTION 1 - INTRODUCTION

1.1 CONTRACT DATA

Contract N62477-83-D-0190-0002 - Ocean Engineering Services in Support of Underwater Assessments at Various Locations.

This task required engineering services to document an underwater inspection and subsequently assess the integrity of the structural members supporting waterfront facilities at the Naval Amphibious Base, Coronado, California.

1.2 INTRODUCTION TO THE PROJECT

This inspection and assessment has been prepared under the Underwater Inspection Program conducted by the Ocean Engineering and Construction Project Office (FPO-1), Chesapeake Division, Naval Facilities Engineering Command, as part of NAVFAC's Specialized Inspection Program. It covers the inspection of the Fuel Pier, Piers 1 through 15, Bridge, Mammal Pier, Bulkheads 1 and 2, and Marina 1231. The inspection was specifically oriented to the assessment of the physical condition of the concrete and wood structural piles of the Piers and to the condition of the concrete of the Bulkheads.

1.3 POST INSPECTION BRIEFING

Following standard practice in the Underwater Inspection Program, a briefing was given to Naval Amphibious Base Public Works on August 13, 1984. The briefing was given by Mr. Christopher Crilley and Mr. Phillip Scola of Chesapeake Division, Naval Facilities Engineering Command, and Mr. A. J. Blaylock of Blaylock-Willis and Associates, Structural Engineers. Attendant for the Amphibious Base was Lt. David M. Kirkman, Staff Civil Engineer.

SECTION 2 - ACTIVITY DESCRIPTION

2.1 LOCATION

The Naval Amphibious Base is located on the western shore of San Diego Bay south of central Coronado. The Base comprises 257 acres of land most of which was created with dredged hydraulic fill.

2.2 HISTORY

In September, 1942, the Chief of Naval Operations authorized the establishment of a Landing Craft Detachment to be formed at the Destroyer Base, San Diego, California. By June 1943, this unit had outgrown its quarters as more trained men were necessary to carry out the needs of amphibious operations. The Secretary of the Navy, therefore, authorized the establishment of the Amphibious Training Base at Coronado on 12 June 1943.

The property was considered to provide ideal beach conditions for every type of amphibious training with the quiet waters of San Diego Bay on one side and the rougher waters of the Pacific on the other.

On 7 January 1946, the Amphibious Training Base was redesignated the U.S. Naval Amphibious Base, Coronado, California (mailing address Coronado, San Diego, California 92155) and remained a subordinate unit of and under the military command of Commander Amphibious Training Command, Pacific Fleet, and as an activity of the Eleventh Naval District. At this time, its role was expanded from actual training to that of providing a shore Base for support and training of amphibious units and to furnish a shore location for research and testing of equipment.

In 1977, the mission of NAVPHIBASE, Coronado, was modified so that it could support more effectively the training and operations

of the tenant commands and the operational forces of the Pacific Fleet.

2.3 MISSION

The mission of NAVPHIBASE, Coronado is to provide on-base facilities and services as required for the administrative and logistic support of the operating forces, tenant commands, organizations and other United States and Allied units in order to support amphibious, unconventional, inshore and riverine warfare, special warfare and other approved training and operations related thereto.

2.4 ENVIRONMENTAL DATA (1)

The climatic region of San Diego is classified as dry steppe (BSk) Kopen-Geiger classification system. The climate is characterized by ocean-influenced mild temperatures and light to moderate precipitation, primarily during the winter months.

The average annual rainfall recorded at Lindbergh Field seven miles from the Naval Amphibious Base is 10.4 inches. Heavy fogs occur in San Diego Bay approximately 24 days per year, most frequently in the Fall and Winter months.

Air temperature has an annual mean of approximately 63 degrees F. Coldest temperatures (45 degrees to 60 degrees) generally occur in January, and the warmest (68 degrees to 75 degrees) in August and September. Temperatures within the San Diego Bay immediate area are more moderate than the surrounding upland areas.

Characteristic of the Bay area is the predominant sea-land breeze

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(1) Bibliography

which persists as a westerly daytime wind, sometimes with a countering easterly land breeze at night. The average wind velocity at Lindbergh Field is 6.6 knots. Strong winds or gales are infrequent. The maximum wind recorded in San Diego occurred in November of 1944. It was from the southwest and 51 mph.

The larger San Diego area is subject to adverse meteorological conditions that are conducive to the concentration of air pollutants (smog). However, the Bay area experiences fewer air quality impacts due to the prevailing westerly winds and the absence of significant pollutant sources to the west.

San Diego Bay is crescent-shaped, about 22 miles long, and from 1/4 to 2-3/4 miles wide. It covers 18 square miles and contains 300,000,000 cubic yards of water at mean tide. The Bay tidal prism (the volume of water contained between high and low tide horizontal planes) is about 1/3 of its total volume.

Water depths in the northern section of the Bay generally exceed 30 feet, with about 70 feet maximum. Average tidal range is 5.6 feet and extreme range is 10.0 feet. The maximum tidal currents at the facilities addressed in this report are less than 2 feet per second.

Historically, the Bay floor and margins are characterized by formational materials, sand, silt, clay and mud deposits. Mud deposits characterize eastern and southern margins of the Bay. Past dredging activities have removed most of the mud deposits in the Bay so that medium dense, silty sands are encountered a few feet below the existing bottom. The deeper deposits are quite dense and exhibit considerable structural competence.

The State of California is within an active seismic region. San Diego has experienced mild earthquakes in recorded history, but none have been catastrophic. There are several fault systems in

Southern California which must be considered in making a seismic assessment of the Naval Amphibious Base for potential earthquake damage. These include the Rose Canyon and La Nacion Faults which are in the vicinity (ten miles and six miles respectively), the Elsinore Fault located 50 miles to the east, the San Jacinto Fault 75 miles distant to the east, and the San Andreas Fault 85 miles to the east. It is understood that the largest probable magnitude earthquake would be generated by the San Andreas Fault (8.3 Richter scale). However, the San Jacinto Fault with a maximum probable magnitude of 7.8 could produce the largest ground acceleration in San Diego due to its closer proximity. That acceleration is estimated to be 20 percent g (gravity).

As described above, some of NAVPHIBASE is reclaimed tidelands produced by dredged fill. These soils are susceptible to liquifaction in the presence of strong seismic energy waves, with resulting threat to existing structures.

Water quality in San Diego Bay is presently acceptable for most human activities, including water recreational purposes. In recent history, it has not always been this good. The first collection plant for area sewage was constructed by the City in 1887 to collect the random discharges that were polluting the Bay. The pollution had been so concentrated that the Navy had expressed concern that the Bay waters were affecting the paint on naval vessels. However, untreated and partially treated sewage continued to be discharged into the Bay by the surrounding communities until 1963.(2)

At that time, industrial and municipal sewage discharges were required to flow into the San Diego Metropolitan Sewage System. This system discharges its effluent into the ocean west of Point Loma.

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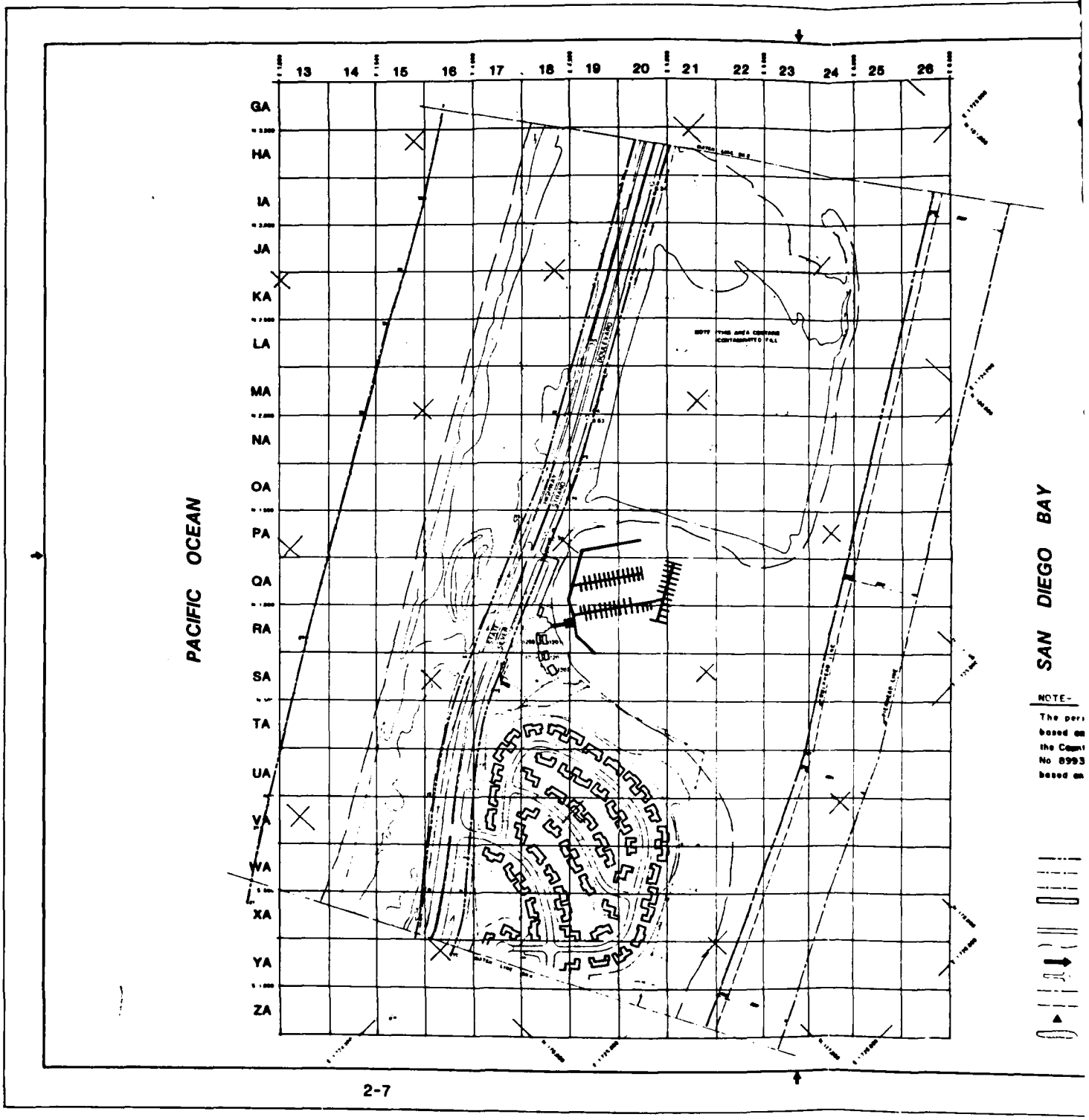
(2) Bibliography

The concentration of sulphate ion in open ocean water is high enough to create an environment hostile to Portland cement concrete. The additional sulphate ion concentration caused by the previous sewage discharge into the Bay magnified the problem.

Reinforced concrete facilities in the Bay have suffered varying degrees of sulphate damage. This damage is characterized by surface softening of the concrete. However, none of the facilities investigated at NAVPHIBASE exhibited significant sulphate damage.

Marine vegetation exists within San Diego Bay in the forms of various species of algae and one species of sea grass. The sea grass grows in the calm water near shore areas adjacent to the Training Center. Marine algae are represented by large filamentous forms of red and green algae such as witches hair or mermaids hair. In addition, forms of green algae such as sea lettuce are found attached to rocks and marine structures. Over 200 species of marine invertebrates have been found. Sediment samples reveal infaunal organisms, including many species of polychaetes, small crustaceans and various bivalves.

Marine invertebrates found on pier piling, rocks, and marine floats include lobsters, crabs, worms, mussels, barnacles, echinoderms, sponges, sea anemones, and tunicates. Eighty to ninety different fish species live in the Bay.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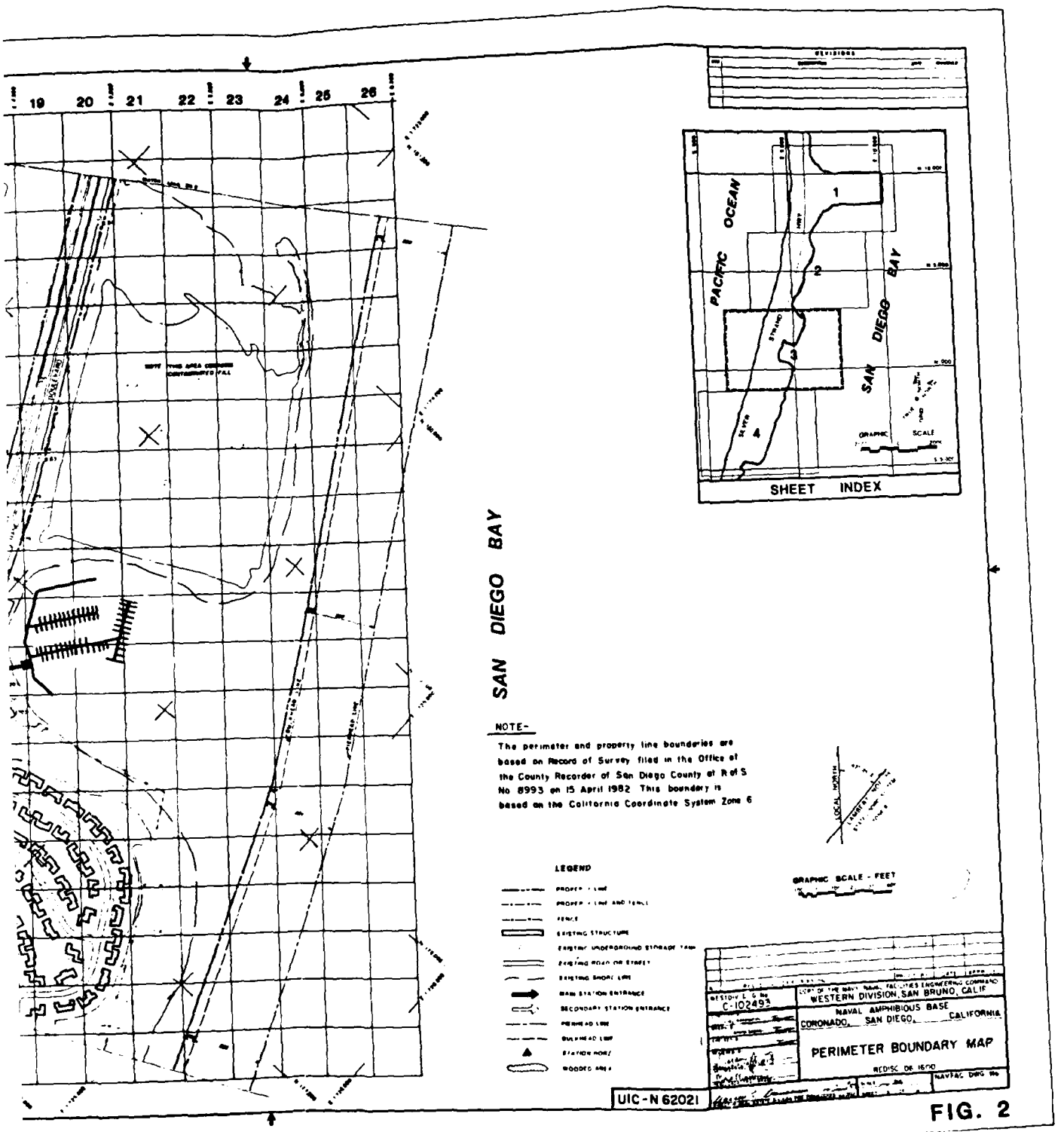
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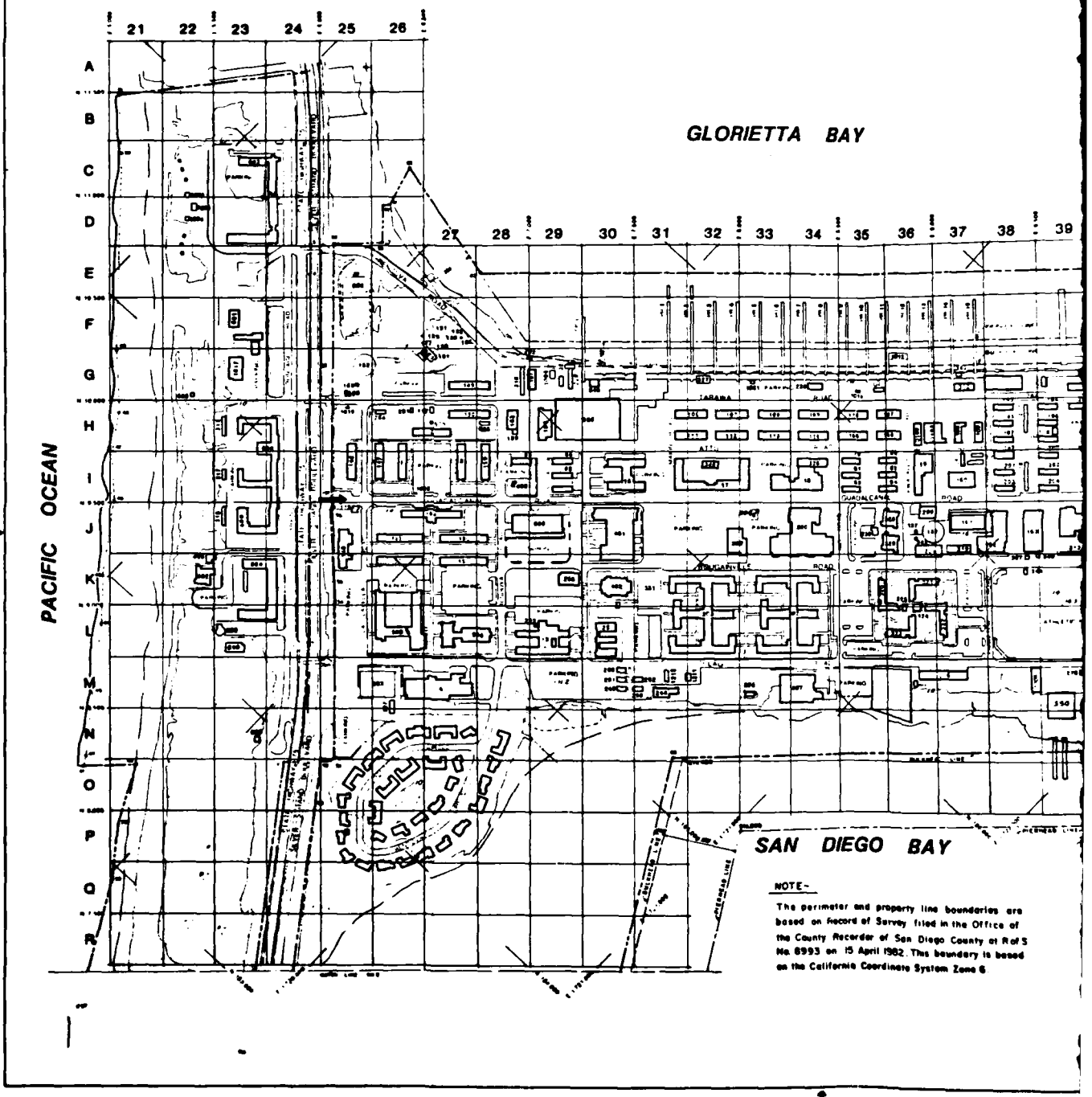
CORONADO, SAN DIEGO, CALIFORNIA
PERIMETER BOUNDARY MAP
UIC-N 62021

FIG. 2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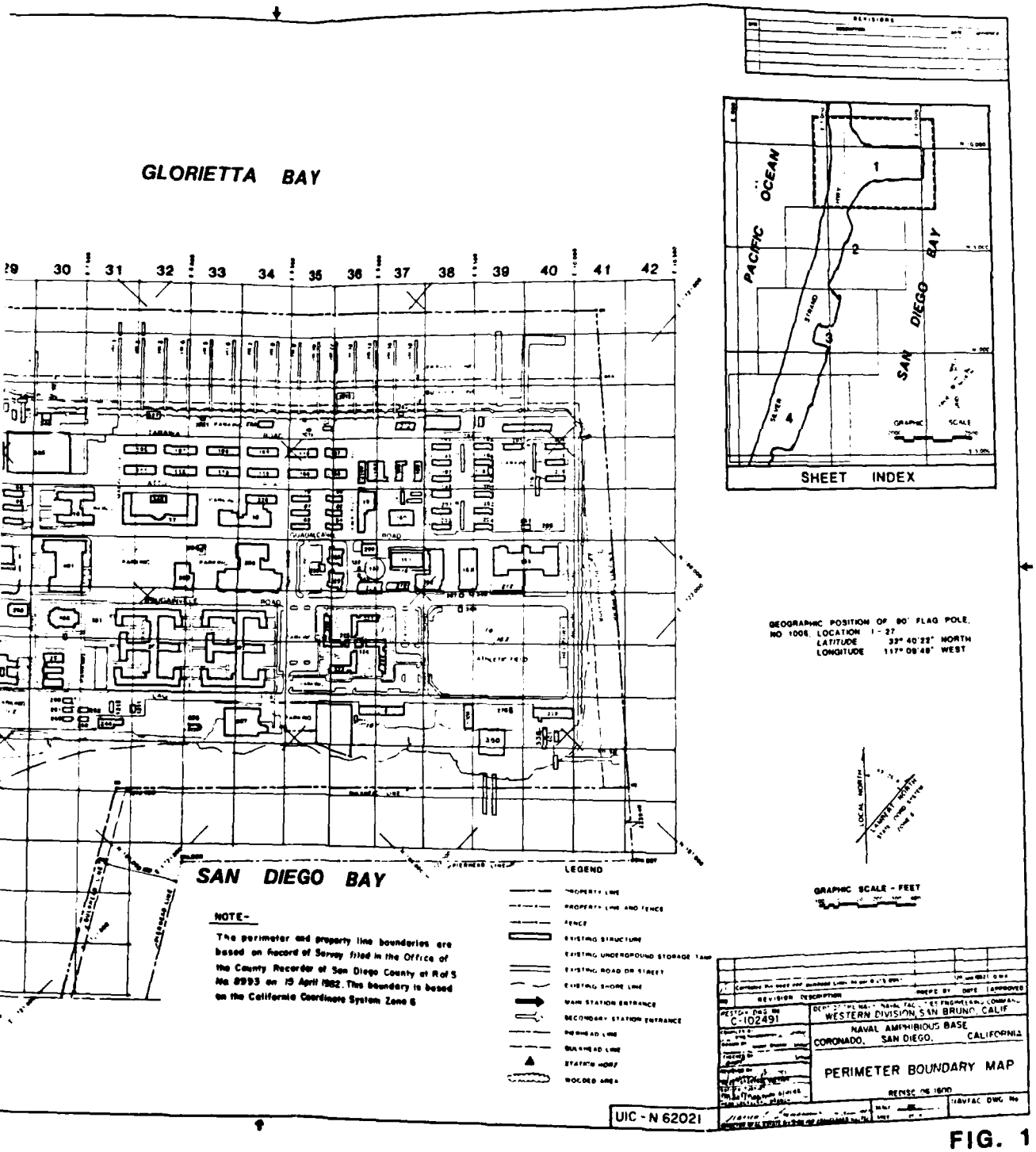
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PACIFIC OCEAN
SAN DIEGO BAY
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GEOGRAPHIC POSITION OF 90' FLAG POLE, NO 1006, LOCATION I - 27
LATITUDE 32° 40' 22" NORTH
LONGITUDE 117° 09' 48" WEST
LOCAL NORTH
GRAPHIC SCALE - FEET
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NAVAL AMPHIBIOUS BASE
CORONADO, SAN DIEGO, CALIFORNIA
PERIMETER BOUNDARY MAP
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UIC - N 62021

FIG. 1

SECTION 3 - INSPECTION PROCEDURE

3.1 LEVEL OF INSPECTION

The on-site underwater inspection phase of the work was performed by teams composed of registered engineers with one engineering technician tendering some of the time. All inspections were conducted in the period between August 6 and August 10, 1984.

Photographs were taken by a commercial underwater photographer supported by the engineering team on August 28, 1984.

The inspection techniques were dictated by the requirements of the Scope of Work and the need for that quality of inspection that would yield the proper information to support accurate assessment and recommendation for the structure inspected.

3.2 INSPECTION PROCEDURE

The work was conducted using three or four engineering divers with one diver serving as tender. The divers were in the same vicinity at all times so that the single tender did not represent a violation of safe diving standards. Communication between diver and tender was by voice.

A Level I general examination was performed on all Pier piles within each of the open type structures. The Level I examination is essentially a swim-by of the entire pile length and does not involve cleaning of any structural elements.

The bulkhead Level I examination included an observation of the entire surface of the wall.

A Level II examination was performed on 15% of the piles in the open type structures. This included hand cleaning of biofouling or

debris on three sides or faces of each square pile to an approximate length of 10 inches to expose underlying pile surface at three heights: mean low water, mudline, and halfway between those elevations.

The Level II examination at the bulkheads included cleaning the sheet pile as follows: At the concrete sheet piling every 200 linear feet a 12 inch square area was cleaned at the three elevations described above when water depth exceeded six feet in depth.

The concrete piling (both bearing piles and sheet piles) were then struck with a pointed hammer at all three elevations to gauge the soundness of the concrete. That soundness was then recorded according to the following nomenclature:

1. Hard: Pick rebounds without making a significant indentation, usually accompanied by a ringing sound clearly heard in the water.

2. Firm: Pick rebounds with a small indentation.

3. Soft: With six blows, 1/4 inch to 1/2 inch indentation can be made.

4. Very Soft: Six blows removes corner of the pile or in excess of 1/2 inch of material.

Record of structural assessment of the concrete sheet piles and concrete bearing piles is shown in Section 5.2.

Chipping was attempted at all four exposed corners at each elevation of all bearing piles and the soundness was recorded.

Each pier pile was inspected at its upper connection to the cap beam for evidence of driving fracture or other damage.

All wood piles were subjected to a modified Level I examination where the entire surface of each pile is inspected for evidence of borer intrusion or other physical damage. This intrusion is often very subtle and localized so that the closer inspection is warranted. The soundness of the wood pile was then recorded according to the following scale:

1. Very good: Damage less than 1/4". Estimated service life in San Diego Harbor 8 years.

2. Good: Damage 1/4" to 1". Estimated service life in San Diego Harbor 6 years.

3. Fair: Damage 1" to 2 1/2". Estimated service life 4 years.

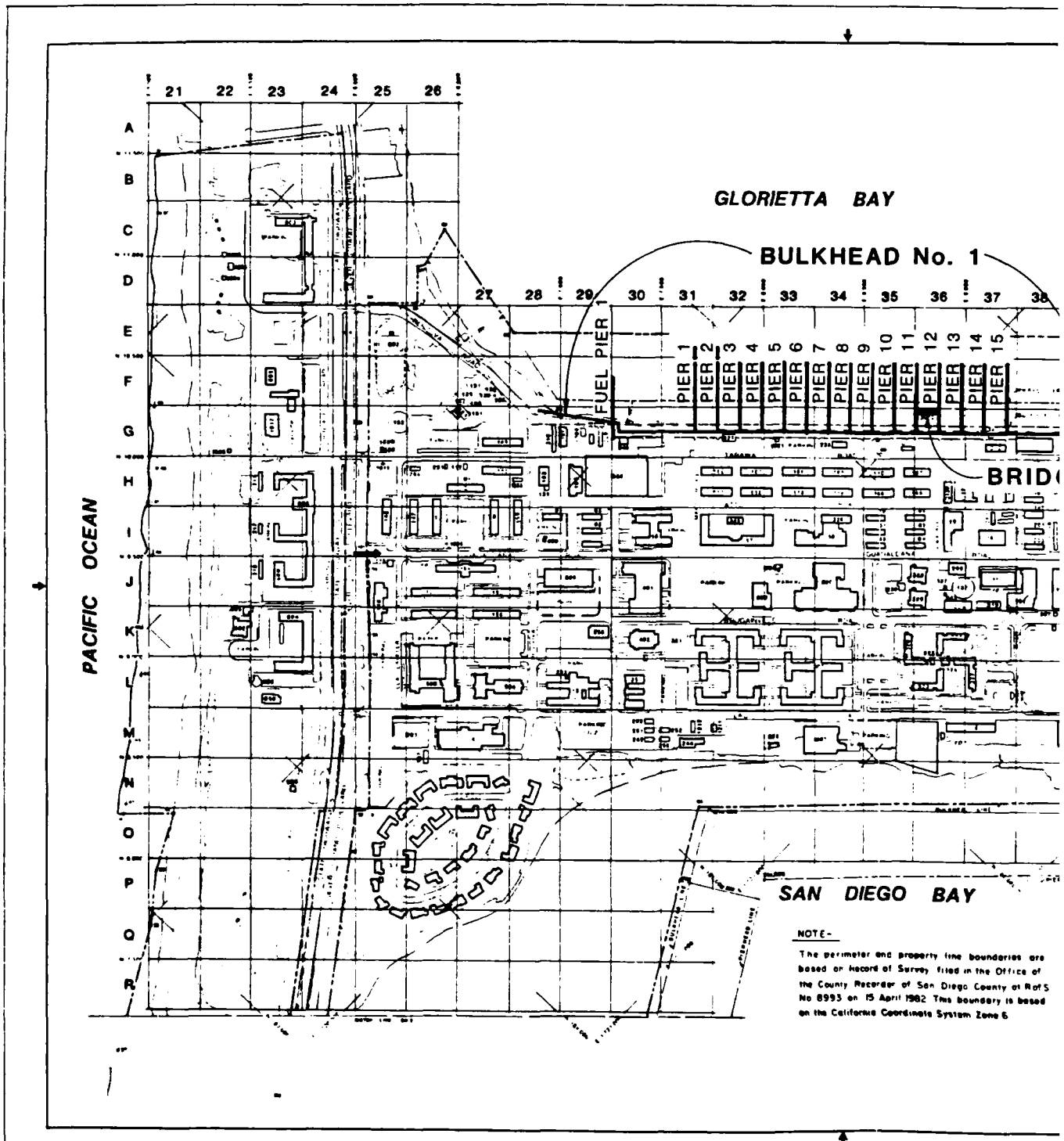
4. Poor: Damage 2 1/2" to 4". Estimated life 1 1/2 years.

5. Bad: Damage greater than 4". No service life.

It should be noted that non-destructive methods of inspection were used in this project. The conditions noted reflect direct observation coupled with an intimate knowledge of similar facilities gained by this office from 25 years of experience with the waterfront structures in San Diego Harbor.

3.3 INSPECTION EQUIPMENT

Equipment used included the usual divers' equipment with scuba gear. Photography equipment included a Nikonos III camera with 15mm wide angle lens and two SR 2000 strobe lights. Chipping hammers and bar scrapers were used to clean and test the piles.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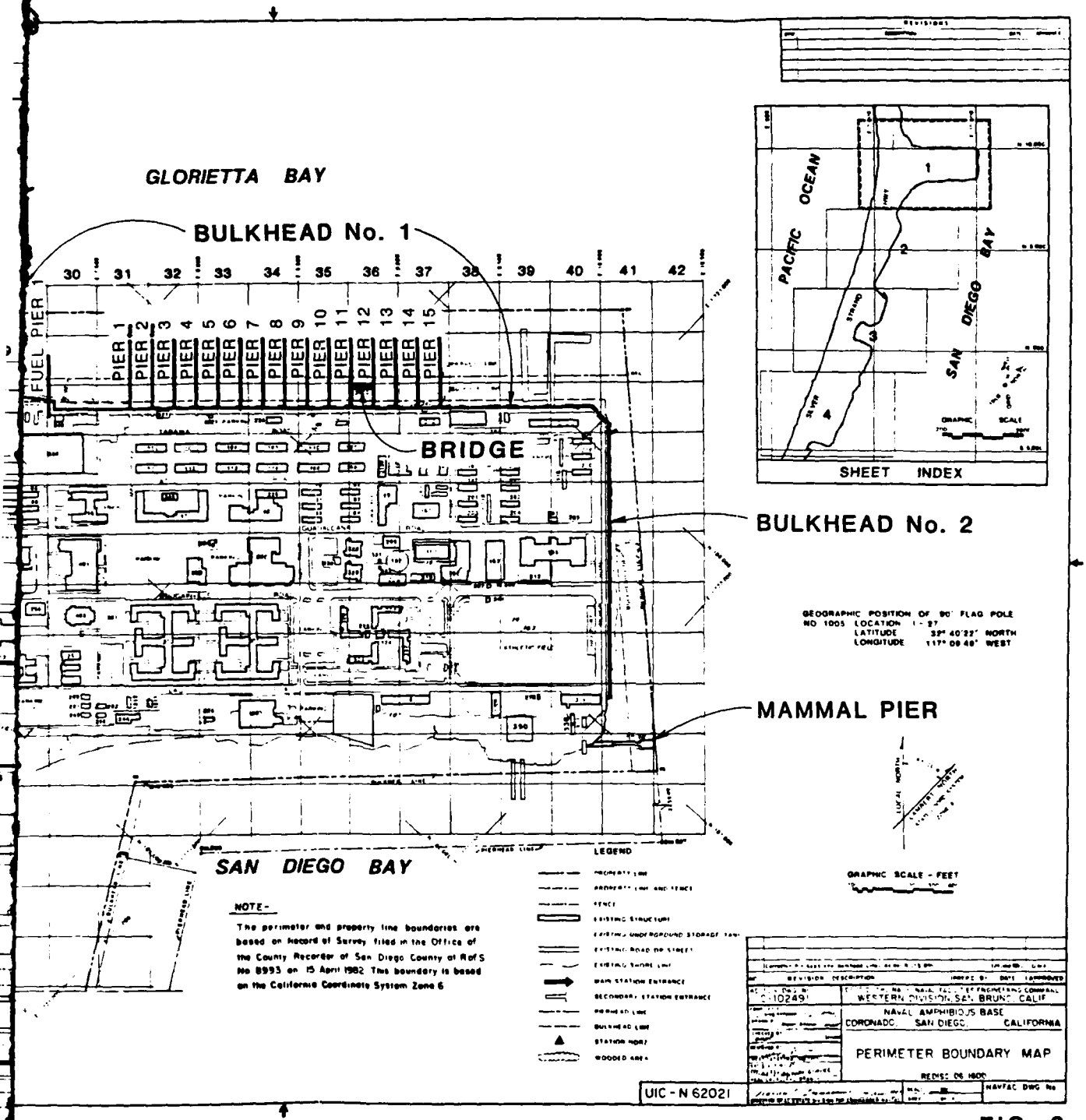
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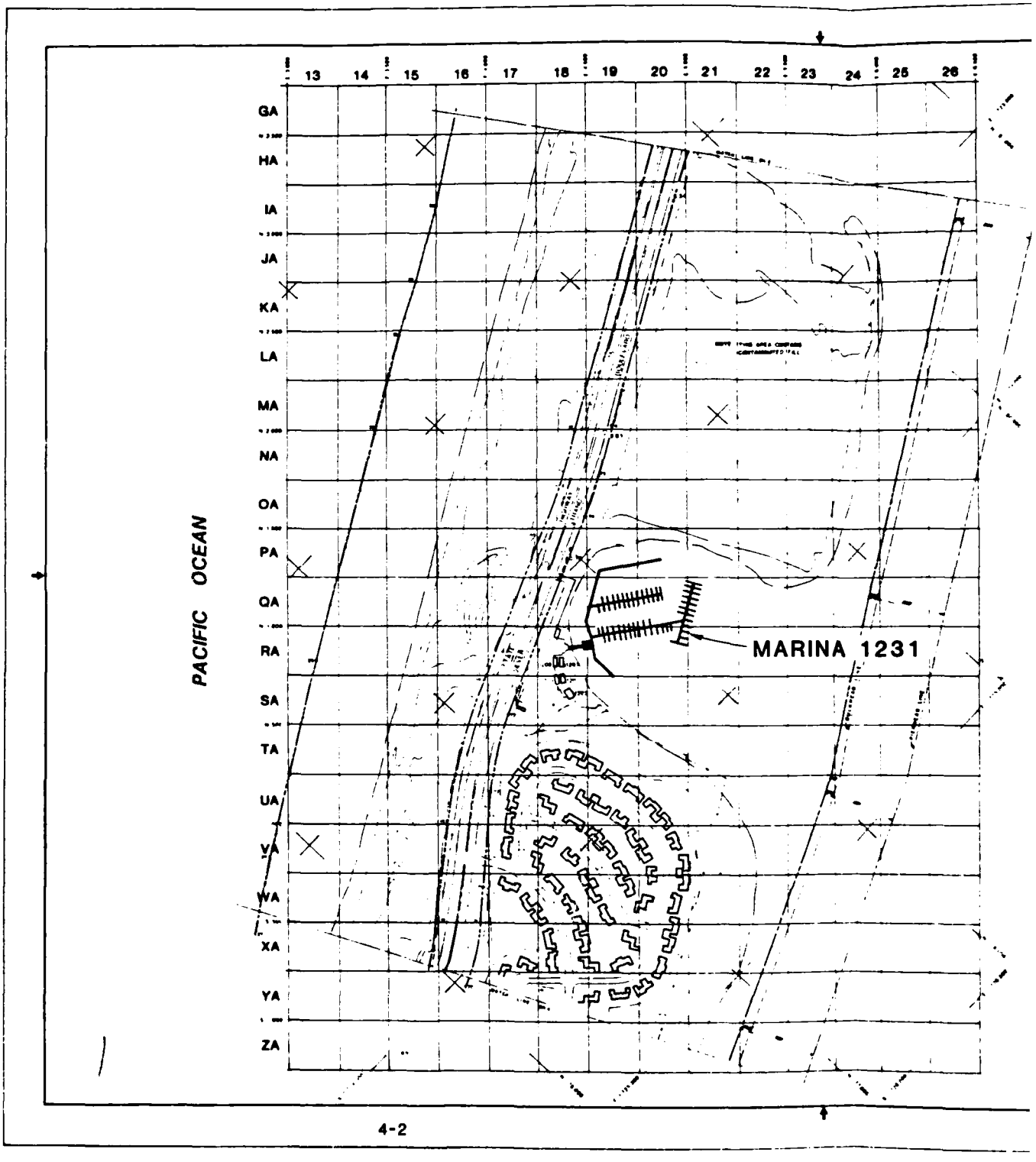
LOCATION 1 - 27
LATITUDE 32° 40' 22" NORTH
LONGITUDE 117° 09' 49" WEST
GRAPHIC SCALE - FEET
NOTE -
The perimeter and property line boundaries are based on Record of Survey filed in the Office of the County Recorder of San Diego County at Ref S No 8993 on 15 April 1982 This boundary is based on the California Coordinate System Zone 6
UIC - N 62021
NAVAL AMPHIBIOUS BASE
CORONADO SAN DIEGO CALIFORNIA
PERIMETER BOUNDARY MAP

FIG. 3


13
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IA
JA
KA
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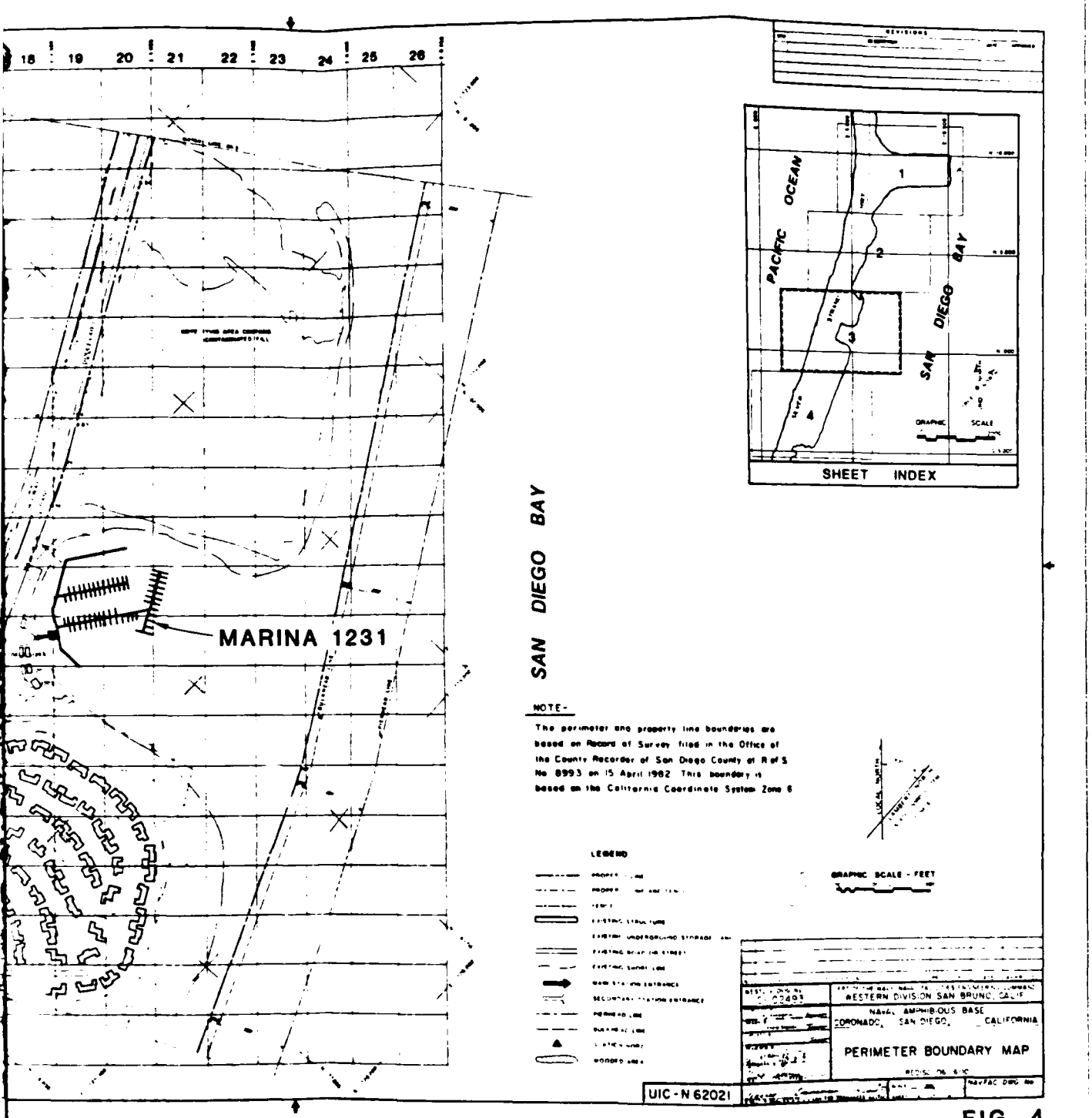
MA
NA
OA
PA
QA
RA
SA
TA
UA
VA
WA
XA
YA
ZA
PACIFIC OCEAN
MARINA 1231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19
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25
26
MARINA 1231
SAN DIEGO BAY
PACIFIC OCEAN
SAN DIEGO BAY
SHEET INDEX
NOTE-
The perimeter and property line boundaries are based on Record of Survey filed in the Office of the County Recorder of San Diego County at R of S No 8993 on 15 April 1982 This boundary is based on the California Coordinate System Zone 6
LEGEND
GRAPHIC SCALE - FEET
WESTERN DIVISION SAN BRUNO, CALIF
NAVAL AMPHIBIOUS BASE
CORONADO, SAN DIEGO, CALIFORNIA
PERIMETER BOUNDARY MAP
UIC - N 62021

FIG. 4

SECTION 4 - FACILITIES INSPECTED

4.1 FUEL PIER

4.1.1 DESCRIPTION OF THE FACILITY

The Fuel Pier is located at the northwestern corner of the San Diego Bay portion of the Naval Amphibious Base. No construction drawings of the Pier could be found by the inspection team. However, it is understood that the facility was constructed in 1956.

The Pier is a reinforced concrete structure. The deck is cast in place, the piles are precast and conventionally reinforced.

The apparent length of the Pier is 242'-0". However, a landside structural extension extends 45'-0" south of the shore end of the structure. The extension is 9'-11" wide. The Pier is 13'-6" wide. There are three raised structures on the Pier deck two of which are Fuel Hose Islands which span the width of the Pier. The Fuel Islands are 5' wide and 12" high and located between Bents 9 & 10 and 13 & 14. The third structure has no clear function but is a 5'-1" wide flat area raised 16" above the pier deck. Clearly, all three structures are obstacles to wheeled traffic.

4.1.2 OBSERVED CONDITIONS

The concrete piles were cleaned and picked with pointed hammers as described above. The underwater surfaces all rated firm or soft. The spalls resulting from the picking all exhibited the whitish color associated with sulphate deterioration. The softer surface areas were noted to favor the south sides of the piling. This phenomenon has been noted before in San Diego Bay.[3] However, no convincing reason for this condition is known.

---

3 Bibliography, Page 4.2

Parts of the upper (above water) piles and adjacent bents have been gunited, Bents 4 through 8. Some cracking and bleeding was noted at the top of Pile 7B and 8A. See "Record of Structural Assessment", Section 5.2.

4.1.3 STRUCTURAL CONDITION ASSESSMENT

The original construction documents for the Pier are not available so that in checking the piles for load capacity assumptions must be made. Allowable load calculations (See Section 5.3) are based on the following:

1. The piles are 16 inch square reinforced conventionally with area of longitudinal reinforcement equal to 2% of the gross area. The reinforcing yield strength is 40 ksi.

2. Spacing and size of lateral ties are proper.

3. The concrete strength f'c = 4000 psi.

4. The piles are considered fixed at the base and restrained for bending at the cap and free to translate at the cap.

5. Pile lengths are computed in accordance with D.M. 25.6 Section 2 and ACI 543R-74 Section 2.3.2.2.

6. Slenderness effect is accounted for by the Modified Rigidity Method outlined in the commentary to ACI 318-83.

7. The combined load calculations and interaction diagrams were developed in accordance with Ultimate Strength Design Criteria of ACI 318-83 and AIC 543-74.

8. The seismic load calculations were developed in accordance with DM 25.1 & AASHTO 1977 with 1983 supplement.

9. All calculations were made based upon the assumption of undamaged piles. This is not entirely an accurate assumption as some sulphate damage has been experienced by the piles. But, it is the opinion of the writer that the damage so sustained is of such minor nature as to justify this simplifying assumption.

The gunited piles which are exhibiting cracking and bleeding are expected to become worse in this regard as time goes on. Eventually, their load carrying capability will be sufficiently reduced that new repairs will become necessary.

For gravity forces, the total capacity of the critical pile (that pile with the greatest exposed length between deck and mudline) was computed. Subtracting the computable dead load of the pier from that capacity leaves the allowable live load which the pile will sustain. This figure is 1400 psf probably much higher than the deck structure will hold, showing the piles to be more than adequate for gravity forces.

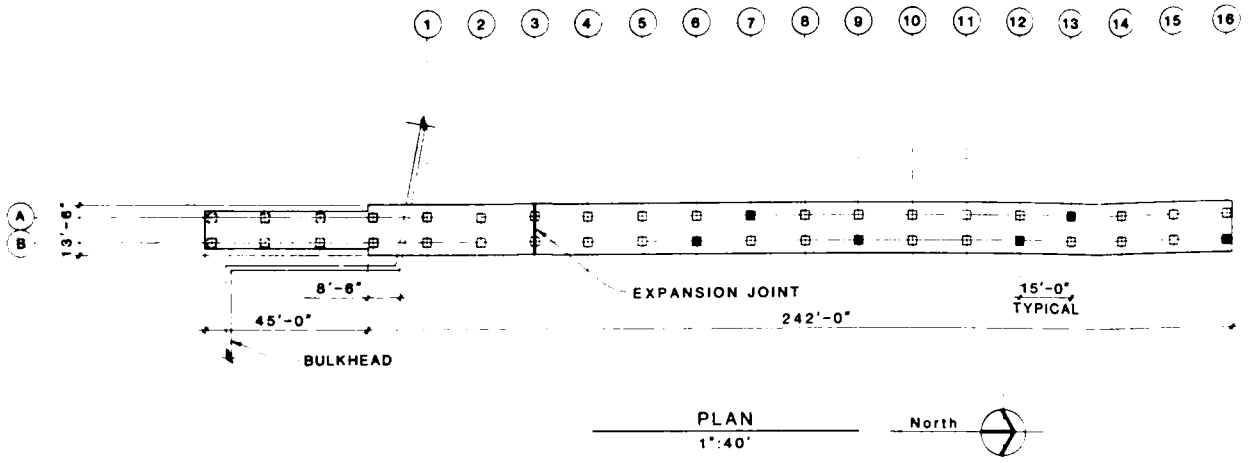
Combining gravity forces with seismic forces applied transversely to the longitudinal axis, and using that pile which has the average stiffness of all the piles, the live load capacity of the critical pile becomes 400 psf.

Combining gravity forces with seismic forces applied parallel to the longitudinal axis, the allowable live load is reduced to 200 psf. The 400 psf live load overstresses the pile by 20% with seismic in this direction.

4.1.4 RECOMMENDATIONS

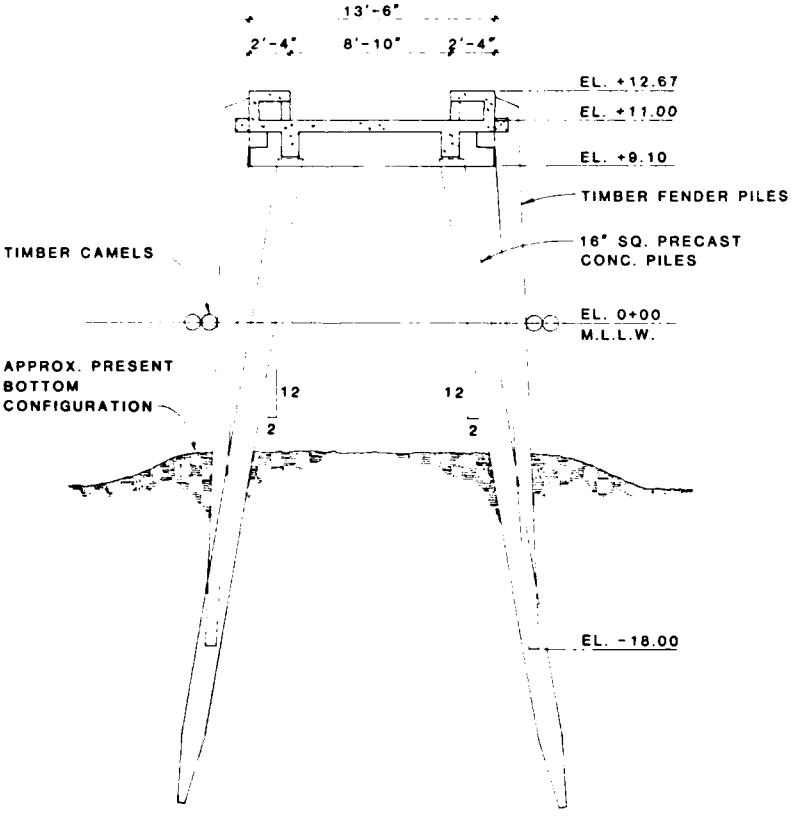
The inspected portions of Fuel Pier have been determined to be in good structural condition. The sulphate damage found is of minor nature and does not significantly reduce the piles

structural capacity. Those gunited piles that are presently cracked and bleeding are considered still capable of sustaining their design loads and no recommendation regarding repair is presently considered in order. It is recommended the piles be inspected again in six years.

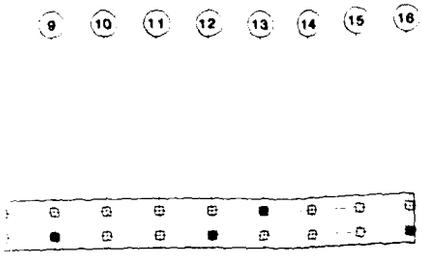


PLAN
1":40'

North



TYPICAL PIER SECTION
1/8":1'-0"



NOTES:

1. □ INDICATES 16" SQ. CONC. PILE
2. ■ INDICATES CLEANED PILE

EL. +12.67

EL. +11.00

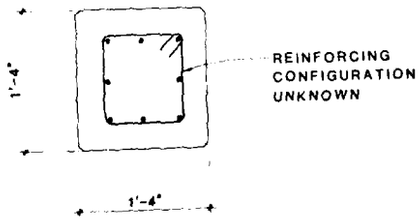
EL. +9.10

TIMBER FENDER PILES

16" SQ. PRECAST
CONC. PILES

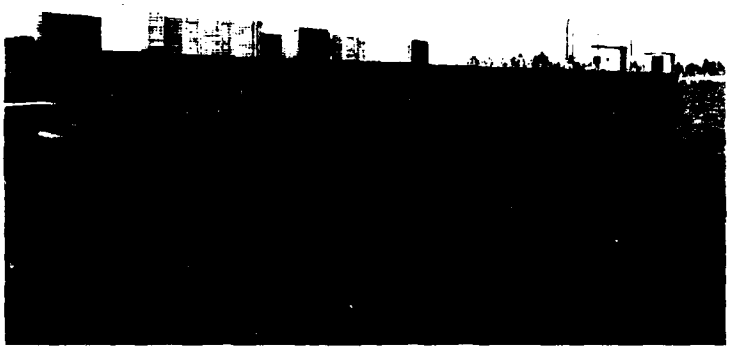
EL. 0+00
M.L.L.W.

EL. -18.00



TYPICAL PILE SECTION
3/4":1'-0"

FUELING PIER PLAN AND TYPICAL SECTIONS NAVAL AMPHIBIOUS BASE, CORONADO, CALIFORNIA		
Blaylock-Willis and Associates STRUCTURAL ENGINEERS SAN DIEGO, CALIFORNIA	DATE: NOV. 1984	FIG. 5



1. Fuel Pier. Picture taken to the northwest. The Fuel Pier is very similar in construction to Piers 1 through 15.

4.2 PIERS 1-15 & BRIDGE

4.2.1 DESCRIPTION OF THE FACILITY

Piers 1 through 15 are a series of similar Piers extending north from the north side of the San Diego Bay portion of the Naval Amphibious Base. Pier 1 is parallel to and approximately 400 feet east of Fuel Pier. Evenly spaced to the east of Pier 1, the other Piers extend for about 1750 feet along the shore so that Pier 15 is located approximately 450 feet west of the eastern face of the Base.

No construction drawings of the Piers or Bridge could be found by the inspection team. However, it is understood that they were built in 1954.

The measured length of the Piers is 356'-9". Their width is 12'-10". There are no raised sections of deck which would restrict travel of small wheeled vehicles as at Fuel Pier.

The Bridge spans east-west between Piers 11 and 12. It is located between Pier bents 7 and 9. It is 97 feet in length and is 24'-1" wide. Its three pile bents are irregularly spaced as though designed specifically for irregular deck mounted equipment loads.

4.2.2 OBSERVED CONDITIONS

The concrete piles were cleaned and picked with pointed hammers as described above. The underwater surfaces all rated firm or moderately soft.

It was observed that many of the piling had gunite repairs in their upper sections above low water. Again, no plans for these repairs were available to the inspection team. However, it is clear that the gunite represents attempts to repair spalling and rust

damage experienced by the piles. Most of the repairs appear quite sound but a few as noted in "Record of Structural Assessment" (Section 5.2) show cracks in the gunite and ferric bleeding. These comments apply to both Piers and Bridge.

4.2.3 STRUCTURAL CONDITION ASSESSMENT

The original construction documents for the Piers and Bridge are not available so that in checking piles for load capacity some assumptions must be made. Allowable load calculations (See Section 5.3) are based on the following criteria:

1. The piles are 16 inch square reinforced conventionally with area of longitudinal reinforcement equal to 2% of the gross area. The reinforcing yield strength is 40 ksi.

2. Spacing and size of lateral ties are proper.

3. The concrete strength f'c = 4000 psi.

4. The piles are considered fixed at the base and restrained for bending at the cap and free to translate at the cap.

5. Pile lengths are computed in accordance with D.M. 25.6 Section 2 and ACI 543R-74 Section 2.3.2.2.

6. Slenderness effect is accounted for by the Modified Rigidity Method outlined in the Commentary to ACI 318-83.

7. The combined load calculations and interaction diagrams were developed in accordance with Ultimate Strength Design Criteria of ACI 318-83 and ACI 543-74.

8. The seismic load calculations were developed in accordance with D.M. 25.1 & AASHTO 1977 with 1983 supplement.

9. All calculations were made based upon the assumption of undamaged piles. This is not entirely an accurate assumption as some sulphate damage has been experienced by the piles. But, it is the opinion of the writer that the damage so sustained is of such minor nature as to justify this simplifying assumption.

The gunited piles which are exhibiting cracking and bleeding are expected to become worse in this regard as time goes on. Eventually, their load carrying capacity will be sufficiently reduced that new repairs will become necessary.

For gravity forces, the total capacity of the critical piles (that pile with the greatest exposed length between deck and mudline) was computed. Subtracting the computable dead load of the pier from that capacity, leaves the allowable live load which the pile will sustain. This figure is 1400 psf probably much higher than the deck structure will hold, showing the piles to be more than adequate for gravity forces.

Combining gravity forces with seismic forces applied transversely to the longitudinal axis, and using that pile which has the average stiffness of all the piles, the live load capacity of the critical pile becomes 400 psf.

Combining gravity forces with seismic forces applied parallel to the longitudinal axis, the allowable live load is reduced to 200 psf. The 400 psf live load overstresses the pile by 20% with seismic in this direction.

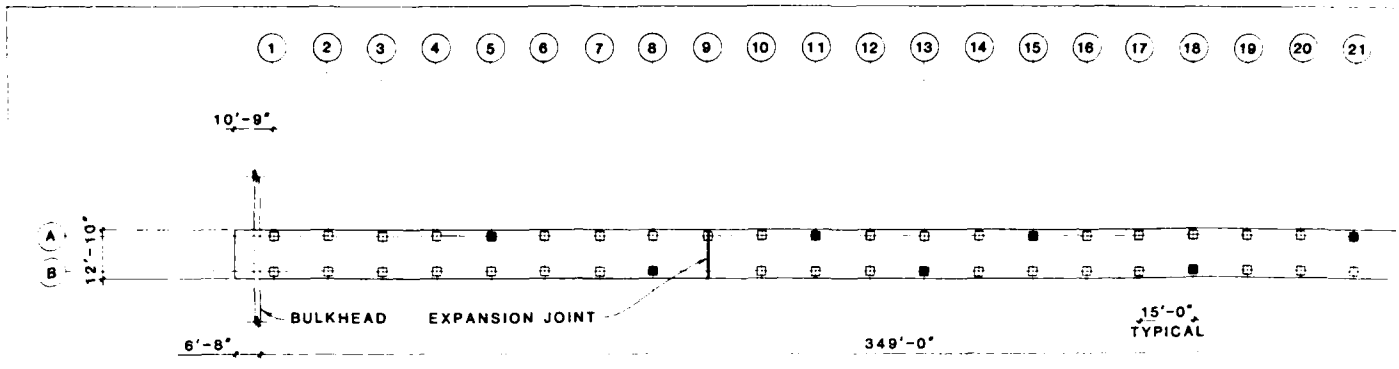
4.2.4 RECOMMENDATIONS

The inspected portions of Piers 1 through 15 and the Bridge have been determined to be in satisfactory structural condition. The gunited piles that are presently cracked and bleeding are

considered still capable of sustaining their required design loads and no recommendation regarding repair is presently considered in order.

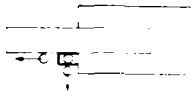
The sulphate damage found is of minor nature and does not significantly reduce the piles structural capacity.

It is recommended that the piles be inspected again in six years.

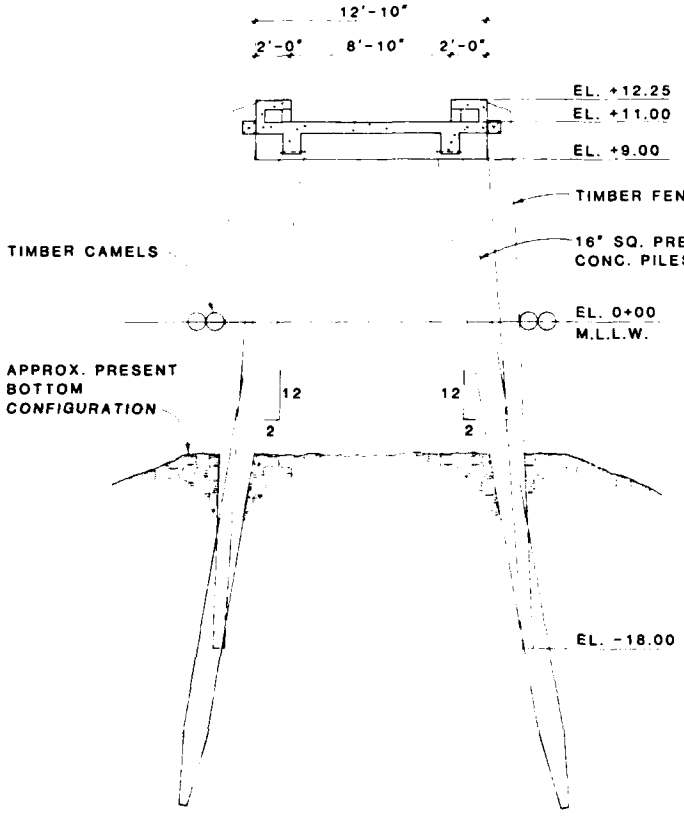


TYPICAL PIER - 1 THROUGH 15
1":40'

North



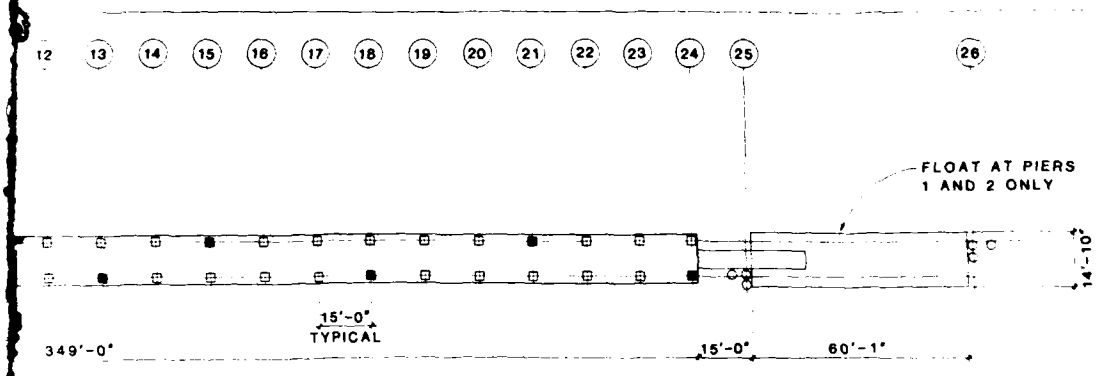
FLOAT
1":30'



NOTES:

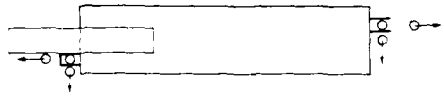
1. ○ INDICATES TIMBER PILE
2. ○— INDICATES TIMBER BATTER PILE
3. □ INDICATES 16" SQ. CONC. PILE
4. ■ INDICATES CLEANED PILE

TYPICAL PIER SECTION
1/8":1'-0"



ER - 1 THROUGH 15

North



FLOAT AT PIER 1
1":30'

FLOAT AT PIER 2
1":30'

L +12.25
L. +11.00
L +9.00

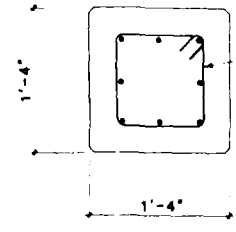
MBER FENDER PILES

6" SQ. PRECAST
ONC. PILES

L 0+00
LLW.

NOTES:

1. ○ INDICATES TIMBER PILE
2. ⊶ INDICATES TIMBER BATTER PILE
3. □ INDICATES 16" SQ. CONC. PILE
4. ■ INDICATES CLEANED PILE



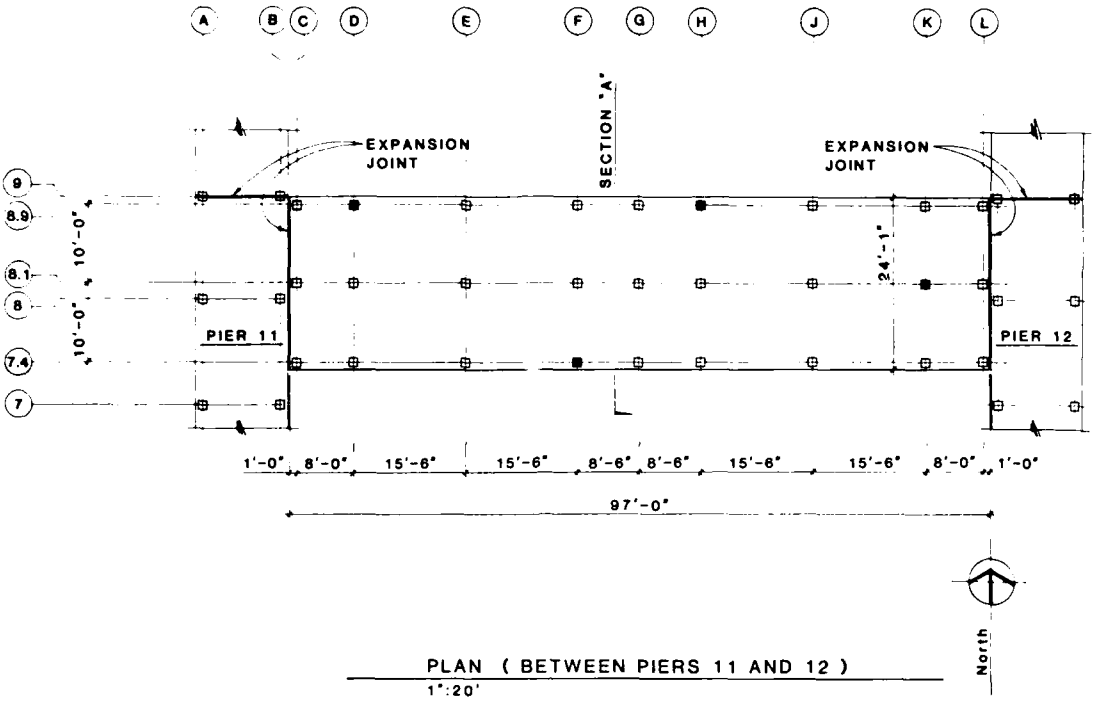
REINFORCING
CONFIGURATION
UNKNOWN

EL -18.00

TYPICAL PILE SECTION
3/4":1'-0"

PIERS 1 THROUGH 15
PLAN AND TYPICAL SECTIONS
NAVAL AMPHIBIOUS BASE, CORONADO, CALIFORNIA

Blaylock-Willis and Associates STRUCTURAL ENGINEERS SAN DIEGO, CALIFORNIA	DATE: NOV. 1984	FIG. 6



PLAN (BETWEEN PIERS 11 AND 12)
1":20'

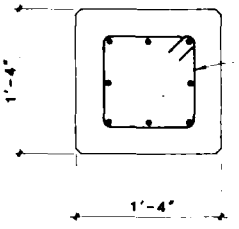
2'-01/2"

TIMBER FENDER PILES

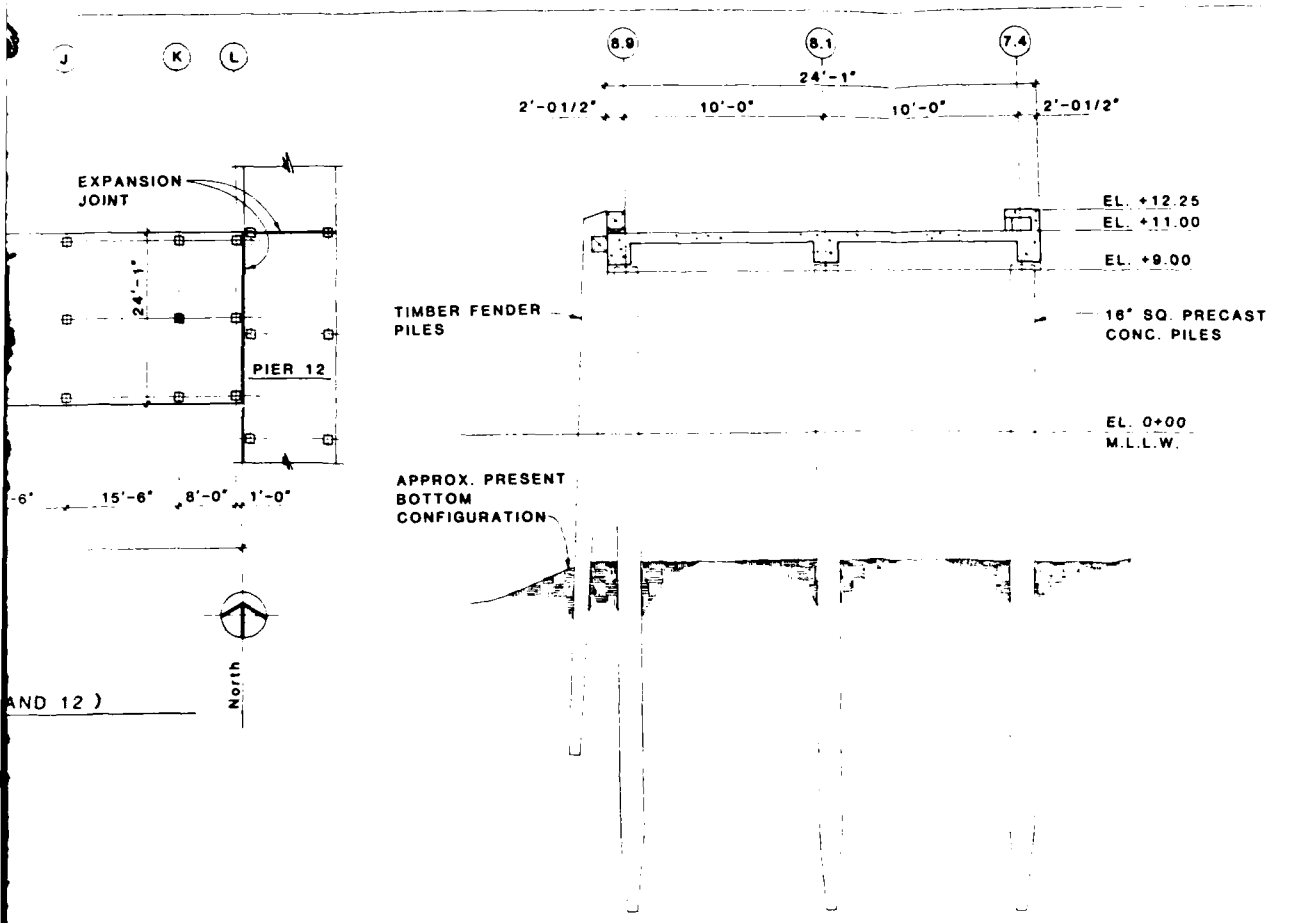
APPROX. PRESENT BOTTOM CONFIGURATION

NOTES:

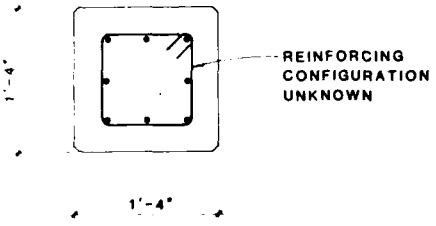
1. □ INDICATES 16" SQ. CONC. PILE
2. ■ INDICATES CLEANED PILE



TYPICAL PILE SECTION
3/4":1'-0"



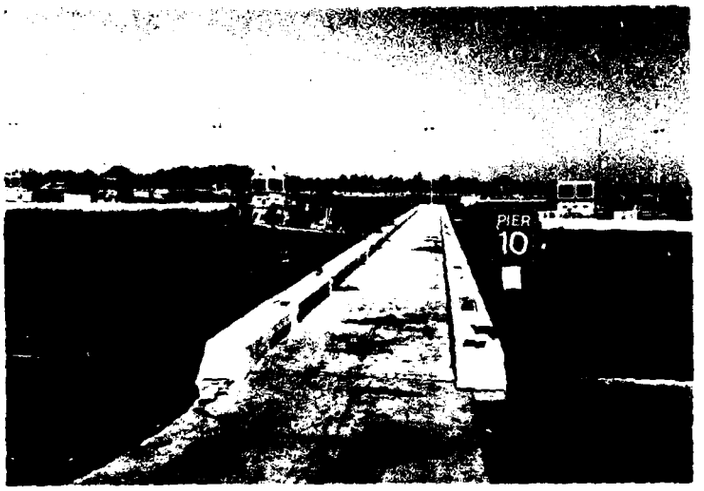
SECTION "A"
1/8":1'-0"



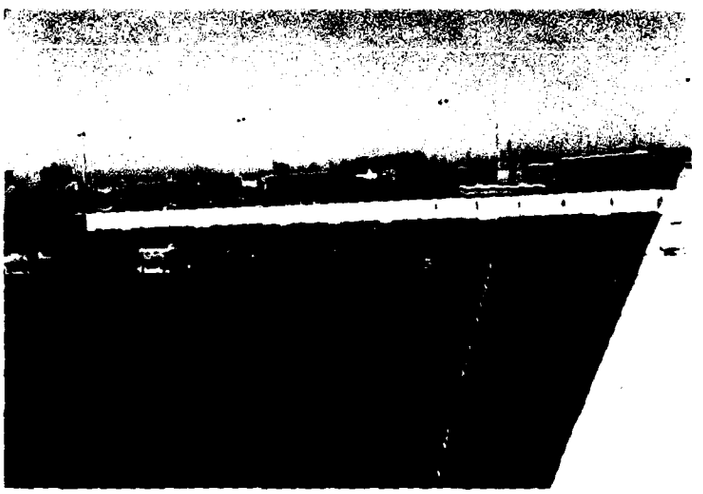
TYPICAL PILE SECTION
3/4":1'-0"

BRIDGE
PLAN AND TYPICAL SECTIONS
NAVAL AMPHIBIOUS BASE, CORONADO, CALIFORNIA

Blaylock-Willis and Associates STRUCTURAL ENGINEERS SAN DIEGO, CALIFORNIA	DATE: NOV. 1984	FIG. 7

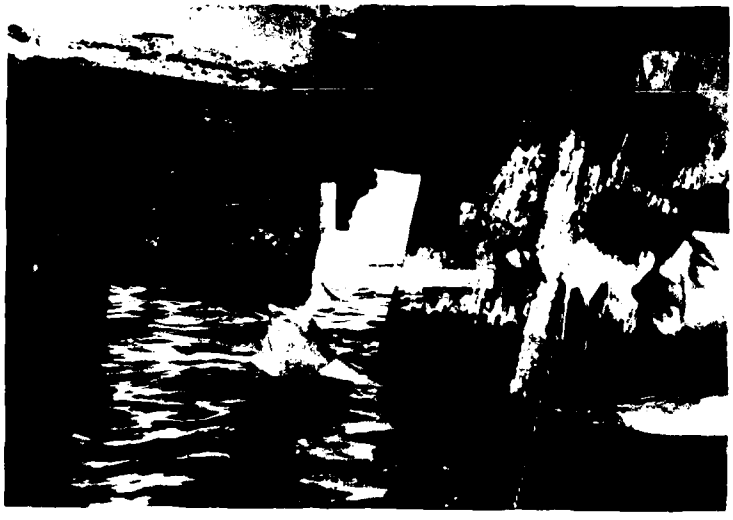


2. Pier 10. Pier is typical of the Piers 1 through 15. Picture is taken to the north.

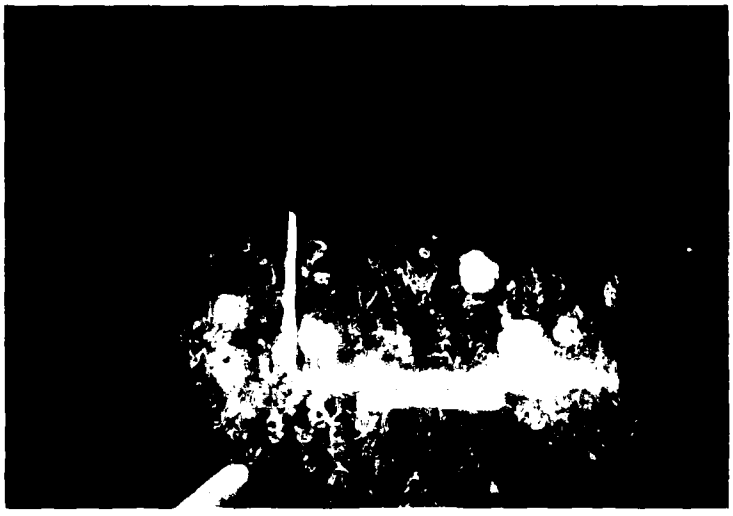


3. Bridge. The Bridge spans east-west between Piers 11 and 12. It does not "bridge" the entire distance in one span but rather is supported by three pile bents at various spacings.

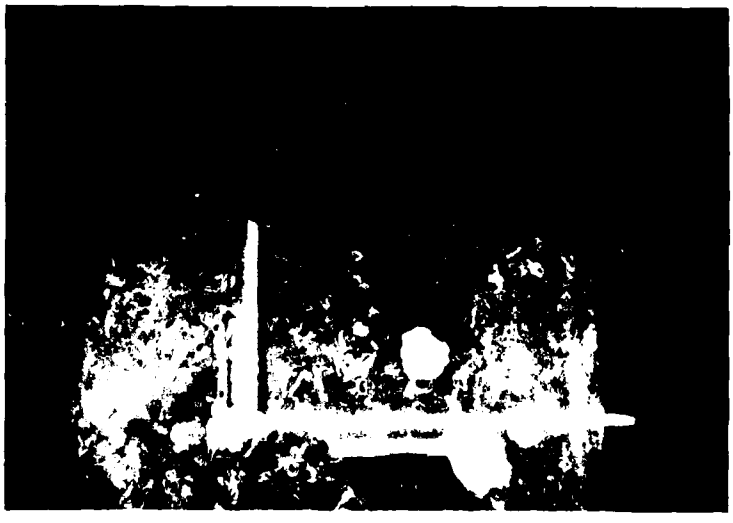
4. Pier 10, Pile 22-B. Picture is taken to the west showing gunite repair to pile which had apparently been struck and broken.



5. Pier 10, Pile 24-A. Pile stub is shown of broken missing pile with replacement along side.



6. Pier 4, Pile 12-B. Picture is taken of cleaned band before picking with pointed hammer.



7. Pier 4, Pile 12-B. Picture taken after picking with pointed hammer. Resulting spall is above 7 on horizontal scale.

8. Pier 4, Pile 15-A. Picture is of cleaned band at mid-height. Picking with pointed hammer produced a spall that was barely discernible.

9. Pier 3, Pile 21-A. Picture is of cleaned band at bottom of pile. Six blows of pointed hammer produce very small spall.

4.3 MAMMAL PIER

4.3.1 DESCRIPTION OF THE FACILITY

The Mammal Pier is a reinforced concrete facility located at the southeast corner of the Naval Amphibious Base. Its longitudinal axis is oriented east-west.

It is designed as three separate elements which have a total length of 314'-6". The inboard element is a platform 20'-1" wide by approximately 114'-6" in length. The center element is an access walkway 12 feet wide by 130 feet in length. The seaward element is a platform 40 feet wide by 70 feet in length. Original construction drawings were made available to the inspection team by the designers of the pier, the consulting engineering firm, Atkinson, Johnson and Spurrier Inc. It was designed in 1976.

4.3.2 OBSERVED CONDITIONS

The Pier is supported on 14 inch square prestressed concrete piles. These were cleaned and picked with a pointed hammer as described above. All underwater surfaces are rated as firm. No evidence of sulphate damage was seen or expected.

Very little significant damage to the piling was noted. Nine of the piles exhibit cracks at their tops suggestive of driving fractures. The pile caps or cap beams, however, indicate considerable cracking, both horizontal and vertical. The vertical cracks are of uniform spacing as though occurring at each vertical stirrup bar and the horizontal cracks occur where the horizontal steel would be located. The plan location of this distress is given in Section 5.2. There is a large spall on the south side of Beam E at Bent 17.

4.3.3 STRUCTURAL CONDITION ASSESSMENT

The inspection team was informed that tanks filled with water had been located on the south side of the outer platform, that as a result, the piling in this area subsided resulting in the southeast corner being depressed below its original elevation. The team was unable to confirm the subsidence or specific damage to the structure that would be expected to result from such subsidence.

The Pier has a slope to the south. All elements were designed with a slope of approximately 1/4 inch per foot of north-south dimension. There is a possibility that the built-in slope was misinterpreted.

The piling are in excellent condition. The driving fractures noted do not significantly reduce the capacity of the piles to support load.

The deck appears in very good condition. The cap beams, however, exhibit distress as previously described. It is not considered to be of a load limiting nature at this time but can be expected to get worse with time.

Design criteria by which the pier was constructed is as follows:

1. Pier Deck - H15 AASHTO Loading or 250 psf uniformly distributed live load.

2. Crane Load - 2 ton hook, jib crane.

3. Seismic Loads - High Potential Facility, Zone 4, K=1, V=ZKCW=0.15W per NAVFAC P-355
   W = Structure dead load plus 20 psf transient live load.

4. Minimum concrete cover for beams is shown as 2 1/2 inches clear to stirrups and 3" clear to principal reinforcement.

5. Pile Criteria:

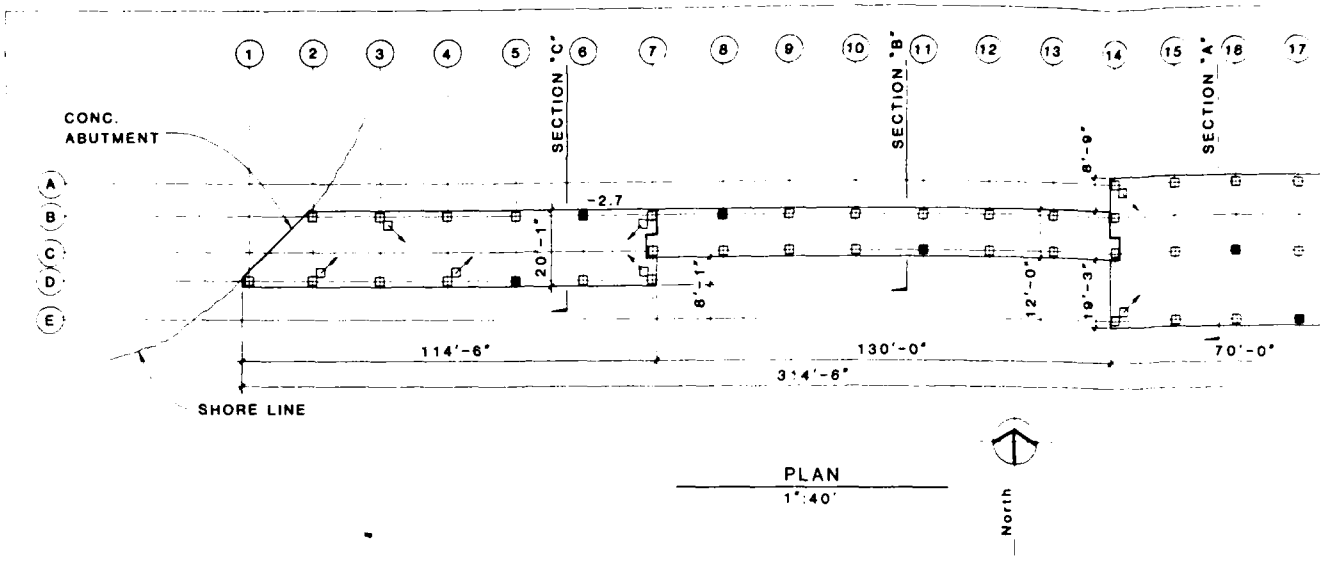
   a. Minimum allowable axial capacity = 140 tons

   b. Required residual prestress = 700 psi

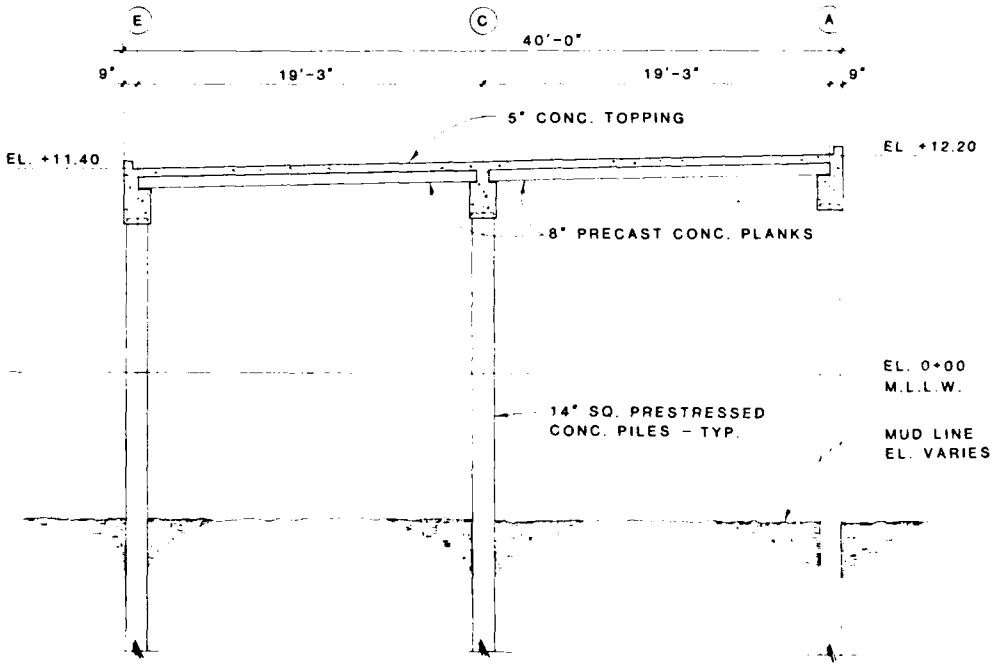
The piles are designed to the requirements of a modern building code (NAVFAC P355) with proper disposition of earthquake forces. No further consideration of pile capacity is made in this report.

4.3.4 RECOMMENDATIONS

It is recommended that the problem of rusting reinforcing with consequent cracking and spalling of the cap beams be addressed by a repair contract. It is further recommended that the Pier be inspected in six years.

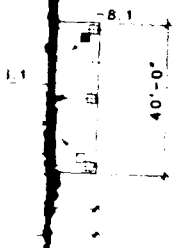


PLAN
1":40'



SECTION "A"
1/8":1'-0"

(18)

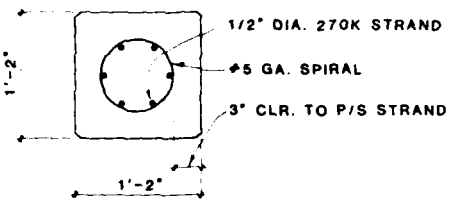


NOTES:

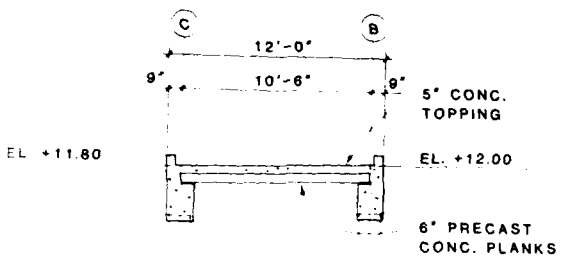
1. □ INDICATES 14" SQ. CONC. VERTICAL PILE
2. ◪ INDICATES 14" SQ. CONC. BATTER PILE
3. ■ INDICATES CLEANED PILE
4. -2.7 INDICATES MUDLINE ELEVATION MEAN LOWER LOW WATER DATUM - EL. 0+00

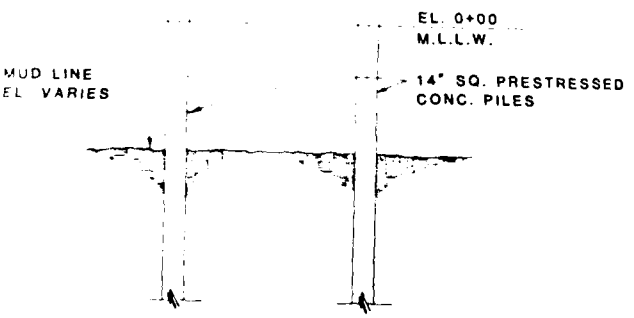
PILE DESIGN CRITERIA:

1. MIN. ALLOWABLE AXIAL CAPACITY: 140 TONS
2. REQUIRED RESIDUAL PRESTRESS: 700 PSI

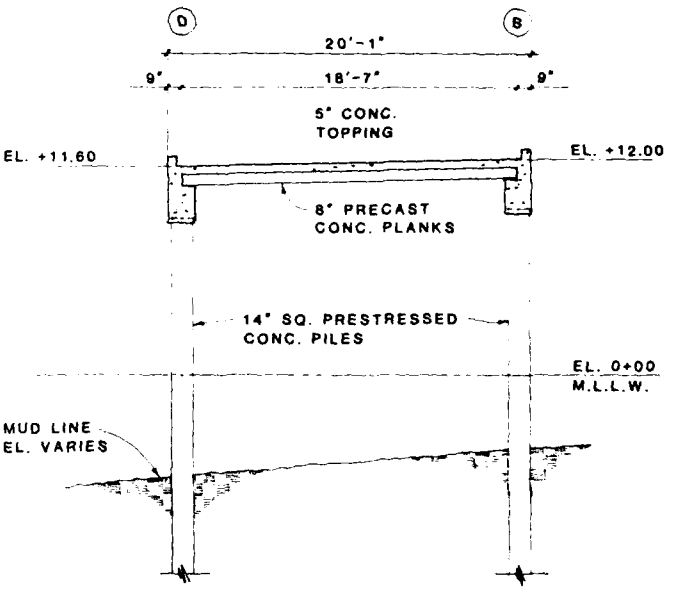


TYPICAL PILE SECTION
3/4":1'-0"





SECTION "B"
1/8":1'-0"



SECTION "C"
1/8":1'-0"

MAMMAL PIER
PLAN AND TYPICAL SECTIONS
NAVAL AMPHIBIOUS BASE, CORONADO, CALIFORNIA

Blaylock-Willis and Associates STRUCTURAL ENGINEERS SAN DIEGO, CALIFORNIA	DATE: NOV. 1984	FIG. 8

10. Mammal Pier. Photo taken to the east.

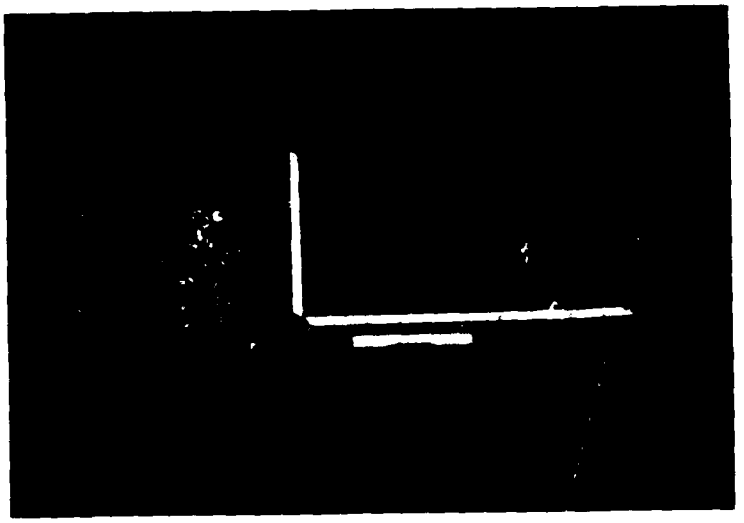
11. Mammal Pier. Picture is of eastern end platform. Southeast corner is at right.

12. Mammal Pier. Picture is taken to the southwest from the northeast corner of the end platform. The pile cap beams lines C and E are shown with past efforts to seal vertical cracks with epoxy.

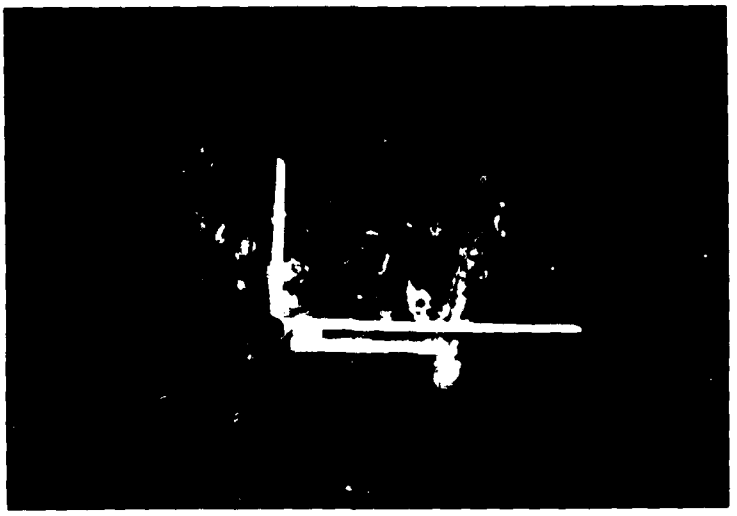
13. Mammal Pier, Pile 17-E. The pile cap beam has spalled and there is rust bleeding and exposed reinforcing at the pile.

14. Mammal Pier, Beam E in vicinity of Pile 17-E. Picture is of longitudinal crack and bottom spalling of the beam.

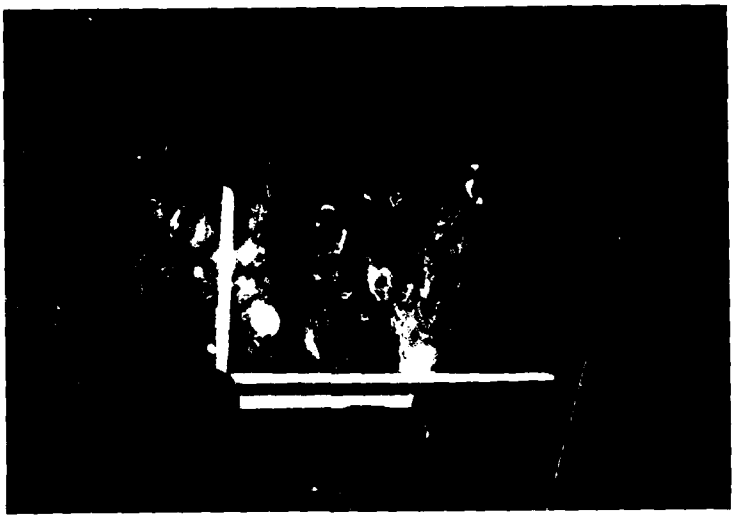
15. Mammal Pier, Pile 11-C at mid-height. Photo is of cleaned band at mid-height previous to picking with pointed hammer.



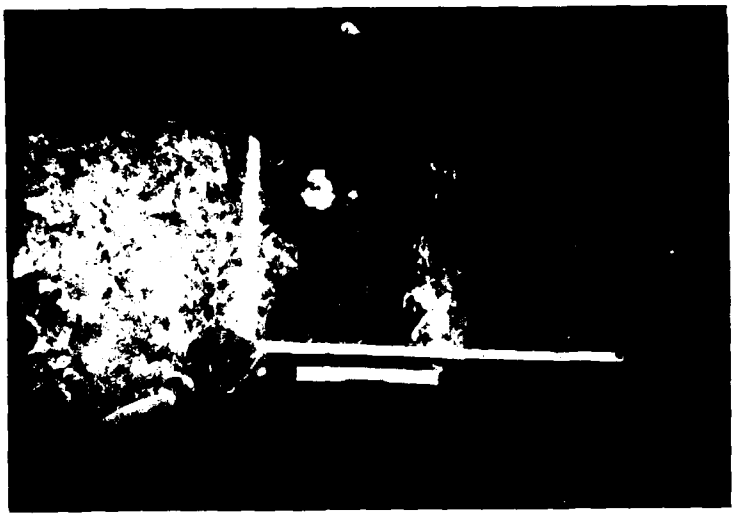
16. Mammal Pier, Pile 11-C at mid-height. Pnoto shows spall made by hammer.



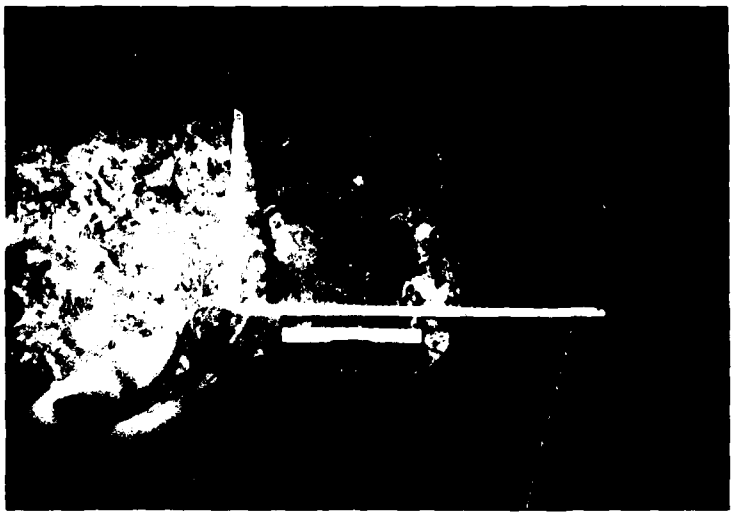
17. Mammal Pier, Battered Pile 18-A. Picture is of cleaned band before striking six blows of pointed hammer.



18. Mammal Pier, Battered Pile 18-A. Picture is of cleaned band after striking with pointed hammer. Spall is above 5 on horizontal scale.



19. Mammal Pier, Pile 16-C. Photo is of cleaned band near bottom of pile.



20. Mammal Pier, Pier 16-C. Photo is of cleaned band after striking with pointed hammer. Spall is above 5 on the horizontal scale.

4.4 BULKHEADS 1 & 2

4.4.1 DESCRIPTION OF THE FACILITY

Bulkhead # 1 is effectively the north boundary of the Naval Amphibious Base. It extends approximately 3200 feet west of the northeastern corner of the San Diego Bay portion of the Base.

Bulkhead # 2 extends south from the northeastern corner of the Base a distance of approximately 1340 feet.

The inspection team was provided plans dated 1951 of the original construction of Bulkhead # 1. They consist of three sheets entitled "Replacement of Piling & Repairs to Waterfront" Specification No. 26743, NOy 24517 Y & D Drawing No. 506835 to 506837. This Bulkhead is located a few feet outboard of an old timber bulkhead which was not removed when the present Bulkhead # 1 was placed.

No plans of construction of Bulkhead # 2 were found. However, the wall appears to be very similar in detail to Bulkhead # 1.

The walls are constructed of conventionally reinforced precast tongue and groove concrete sheet piling. Width of sheets vary between 2 feet and 4 feet. Lengths are 16 feet or 20 feet.

In the approximate 72 feet of Bulkhead # 1 west of the northeast corner of the Base, the plans show a 1 1/4 inch existing tie rod (existing in 1951). Its location is directly in line with the 2 inch center hole cast in the concrete panels. However, no connection to the panel is discernible.

In the field, the panels have a tie rod connection exposed on the surface of the panel so it is assumed the connection was made to the old tie rod. Experience would question the condition of the rods which may have been placed when the Base was first constructed in 1943.

4.4.2 OBSERVED CONDITIONS

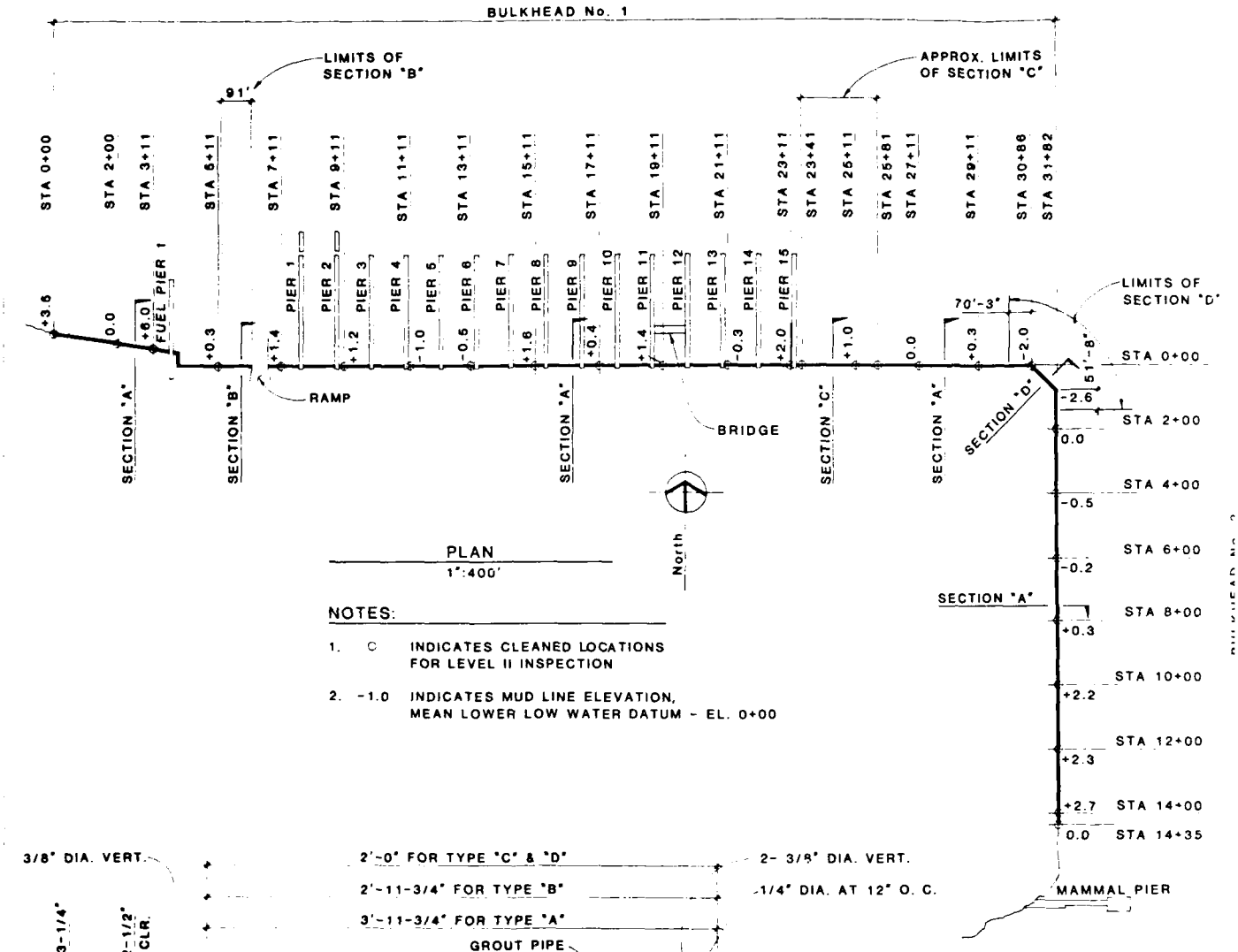
The Bulkheads are quite easy to inspect as much of walls are out of the water at low tide. There are many instances of rusting and swelling reinforcement in the splash zone area of both walls. This is shown by bleeding cracks and in some places spalling with exposed reinforcing steel. Gunite repairs at various locations have been attempted in the past and have generally been successful.

4.4.3 STRUCTURAL CONDITION ASSESSMENT

The bulkheads are considered to be in good condition. The presence of cracking and spalls described above detract from the cosmetic appearance of the structure but do not significantly reduce the load carrying capacity of the bulkheads. However, the periodic repair of new distress with gunite repair must be continued.

4.4.4 RECOMMENDATIONS

It is recommended that continued attention be addressed to the repair of severe spalls when they occur to the Bulkheads and the Bulkheads be inspected again in six years.

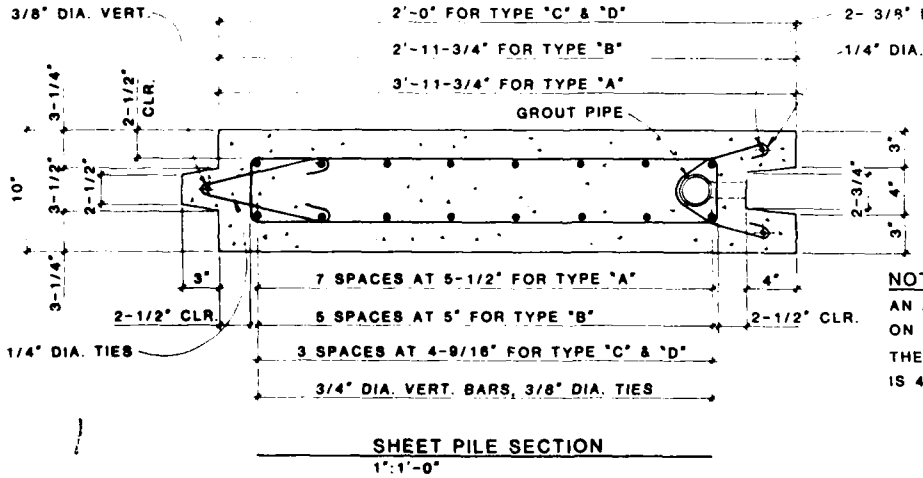


PLAN
1":400'

NOTES:

1. ○ INDICATES CLEANED LOCATIONS FOR LEVEL II INSPECTION

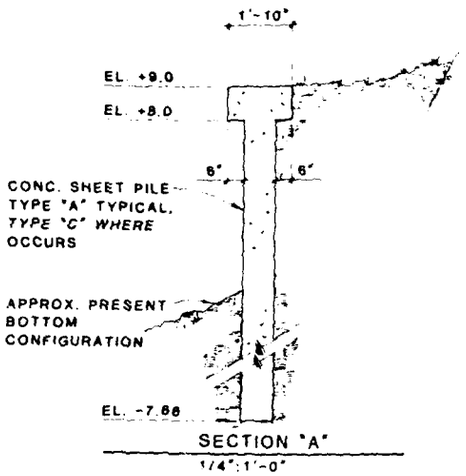
2. -1.0 INDICATES MUD LINE ELEVATION, MEAN LOWER LOW WATER DATUM - EL. 0+00



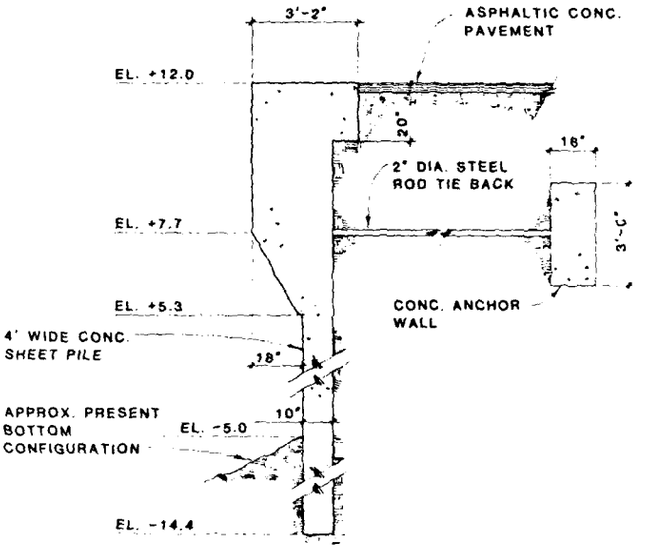
SHEET PILE SECTION
1":1'-0"

NOTE:

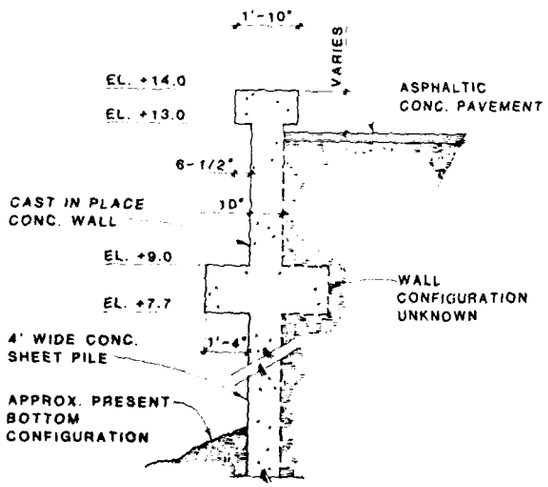
AN ALTERNATE SHEET PILE SECTION IS INDICATED ON THE ORIGINAL CONSTRUCTION DOCUMENTS. THE ALTERNATE IS AS SHOWN EXCEPT THE GROOVE IS 4-1/4"x6" AND THE GROUT PIPE HAS BEEN REMOVE



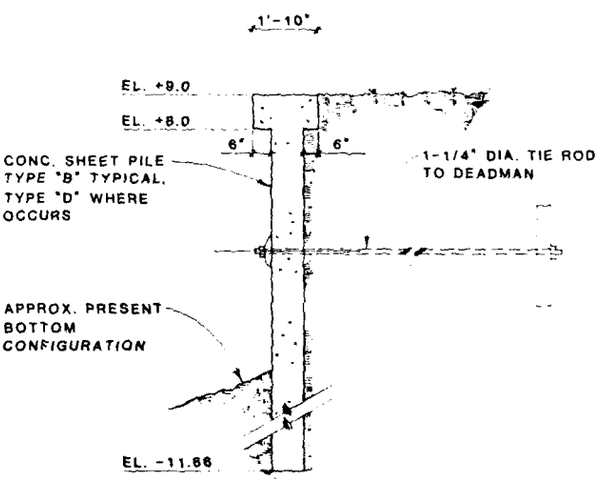
SECTION "A"
1/4":1'-0"



SECTION "B"
1/4":1'-0"



SECTION "C"
1/4":1'-0"

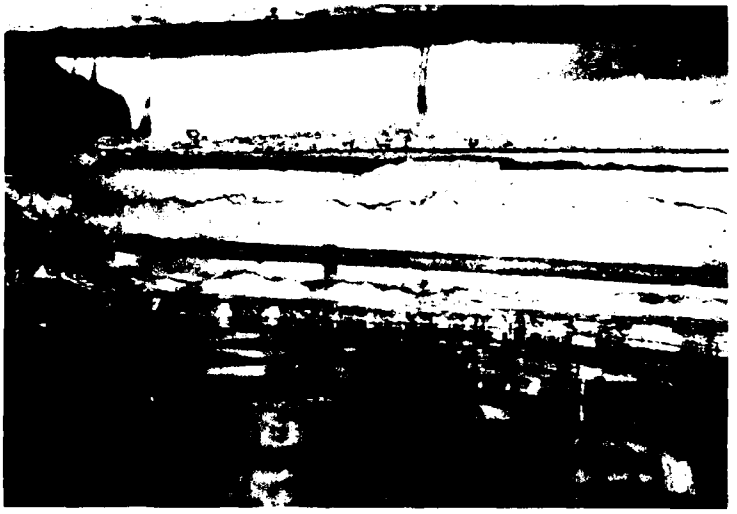


SECTION "D"
1/4":1'-0"

BULKHEADS
PLAN AND TYPICAL SECTIONS
NAVAL AMPHIBIOUS BASE, CORONADO, CALIFORNIA

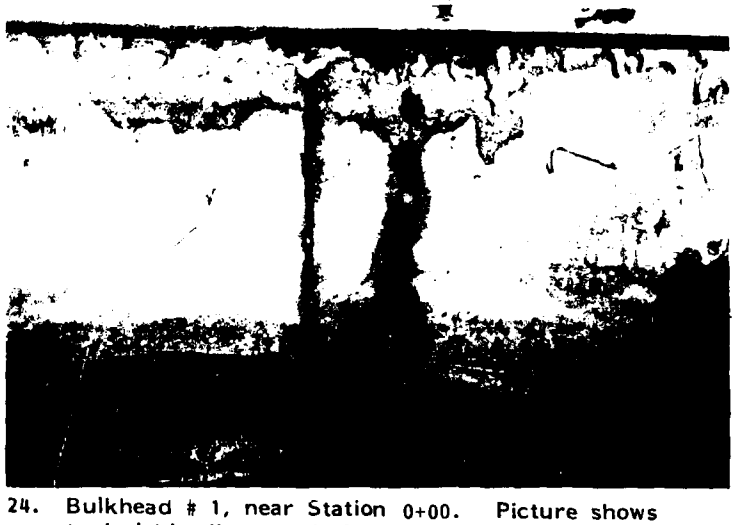
Blaylock-Willis and Associates STRUCTURAL ENGINEERS SAN DIEGO, CALIFORNIA	DATE: NOV. 1984	FIG. 9

21. Bulkhead 1. View is to the east with Fuel Pier in background. Some cracking, spalling and rust bleeding is occurring to the tops of the precast panels.



22. Bulkhead 1, under shoreside end of Pier 10. Photo shows deterioration of Bulkhead cap from rusting horizontal reinforcing steel. Attached utility line has no significance regarding deterioration.

23. Bulkhead # 1. Picture shows horizontal crack caused by rusting reinforcing steel near Station 0+00.



24. Bulkhead # 1, near Station 0+00. Picture shows typical bleeding vertical crack in precast panel.

25. Bulkhead 1, underwater near Station 30+60. Picture is of a typical tie rod connection to the precast wall panels in this section of wall. Presumably, a deadman structure exists some distance behind the wall to which the tie rod is connected.

26. Bulkhead 2. Picture is taken to the north from Station 14+00.

27. Bulkhead 2. Photo shows gunite repair to both cap and wall panel near Station 14+00. Rust bleed is from end of steel rod exposed.

4.5 MARINA 1231

4.5.1 DESCRIPTION OF THE FACILITY

Marina 1231 is located on the eastern shore of the Silver Strand approximately 1.6 miles south of the Naval Amphibious Base gate.

It is comprised of a small fixed pier and approximately 2071 linear feet of floating access walkway and berthing footage. About 1171 lineal feet of access walkway serve finger piers.

The Fixed Pier is constructed entirely of wooden structural members, deck, beams and piles. It is a blunted "T" in shape, and about 1942 square feet in area and is designated Pier 17.

The Floating Piers are supported by guide piles of wood, steel and concrete.

4.5.2 OBSERVED CONDITIONS

The Fixed Pier, Pier 17, appears to be in fair to good condition. The floating structure and its guide piles are in need of repair. At the time of this inspection, a contractor was aboard for the purpose of replacing plywood decking and about 50 wood piles with concrete piles. Notes on field observations are included in Section 5.2 "Record of Structural Assessment".

It was noted that the Floating Piers were constructed of diverse materials. There is plywood plank and concrete decks.

The wood piles of the Fixed Pier were either wrapped in plastic sheets or concrete jacketed. These coverings were properly placed in rows 1 through 3.

In the remaining rows, 4 through 7, the covering did not extend to the mudline and leaves the bottoms of those piles exposed to marine borer damage. It is the writer's opinion that this omission is most inappropriate.

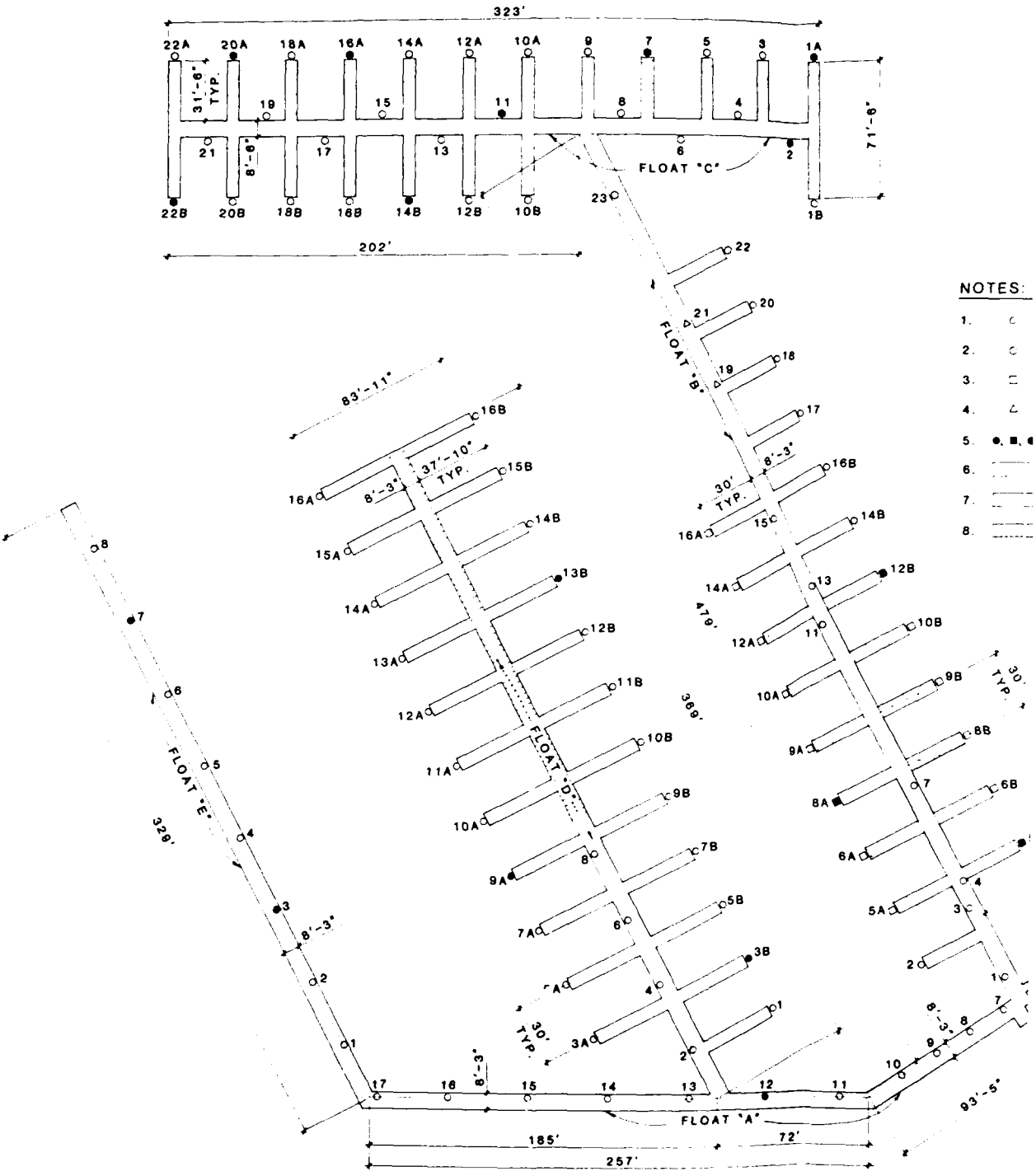
4.5.3 STRUCTURAL CONDITION ASSESSMENT

Many of the wooden piles of the Floating Piers are in poor to bad condition so that present measures taken to replace them with concrete piles are appropriate.

The wooden piles of the Fixed Piers are in much better condition but their exposure due to the incompleteness of their covering threatens their integrity in the next few years.

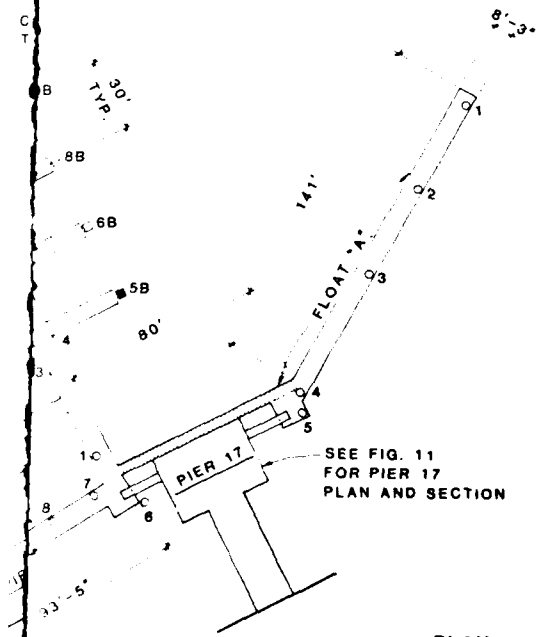
4.5.4 RECOMMENDATIONS

It is recommended that the present attention to the replacement of the wooden piles of the Floating Piers be continued and that efforts be taken to cover the exposed lower sections of the Fixed Pier wooden piles.


323'
22A 20A 18A 16A 14A 12A 10A 9 7 5 3 1A
31'-6" TYP.
19 15 11 8 4
21 17 13 6 2
8'-6"
71'-6"
FLOAT "C"
22B 20B 18B 16B 14B 12B 10B 23 1B
202'
22
21 20
FLOAT "B"
19 18
17
83'-11"
16B
37'-10" TYP.
8'-3"
15B
16A
30' TYP.
15
14B
15A
14A
13B
12B
13A
12A
11B
11
10B
10A
9B
9A
8B
8A
7
6B
6A
5A
4
3
2
1
479'
389'
329'
FLOAT "E"
FLOAT "D"
8
7
6
5
4
3
2
1
8'-3"
30' TYP.
7B
6
5B
4
3B
2
1
17 16 15 14 13 12 11 10 9 8 7
8'-3"
FLOAT "A"
185'
72'
257'
93'-5"
NOTES:
1.
2.
3.
4.
5.
6.
7.
8.

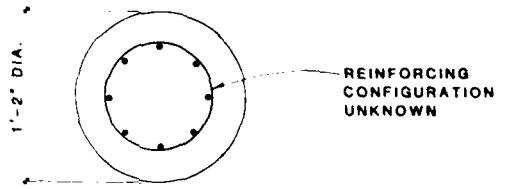
NOTES:

1. ○ INDICATES TIMBER PILE
2. ○ INDICATES 14" DIA. CONC. PILE
3. □ INDICATES 12" SQ. CONC. PILE
4. △ INDICATES 6" DIA. STEEL PIPE
5. ●, ■, ● INDICATES CLEANED PILES
6. INDICATES PLYWOOD DECKING
7. INDICATES CONC. TOPPING
8. INDICATES 2x6 PLANKING WITH 3/4" ± SLOT BETWEEN PLANKS

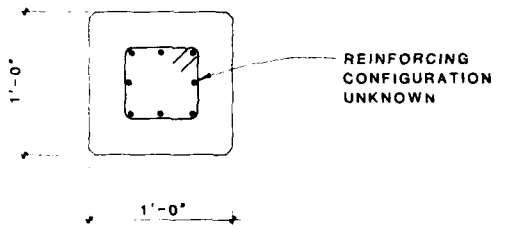


PLAN
1":60'

North



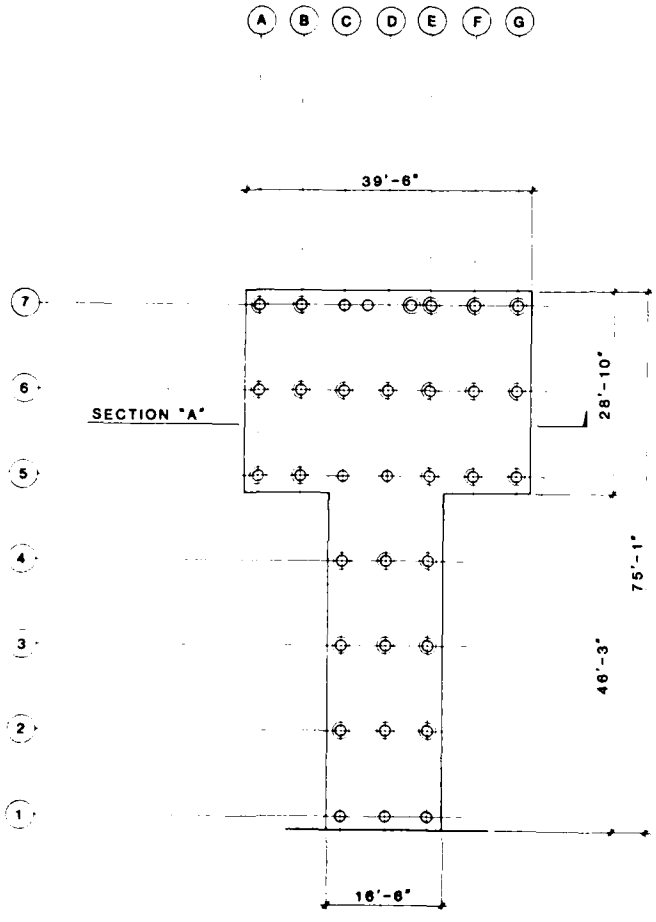
TYPICAL PILE SECTION
1":1'-0"



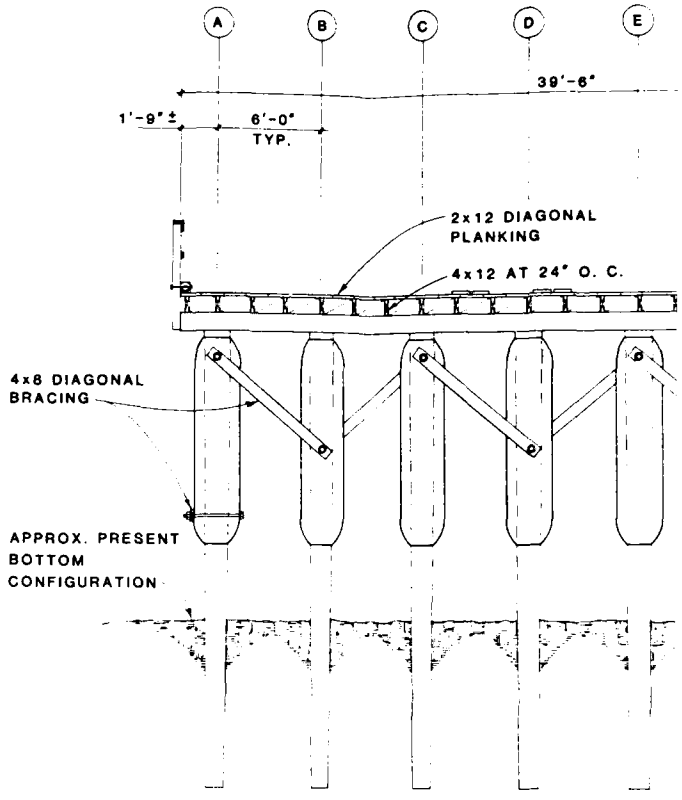
TYPICAL PILE SECTION
1":1'-0"

MARINA 1231
PLAN AND TYPICAL PILE SECTIONS
NAVAL AMPHIBIOUS BASE, CORONADO, CALIFORNIA

Blaylock-Willis and Associates STRUCTURAL ENGINEERS SAN DIEGO, CALIFORNIA	DATE: NOV. 1984	FIG. 10



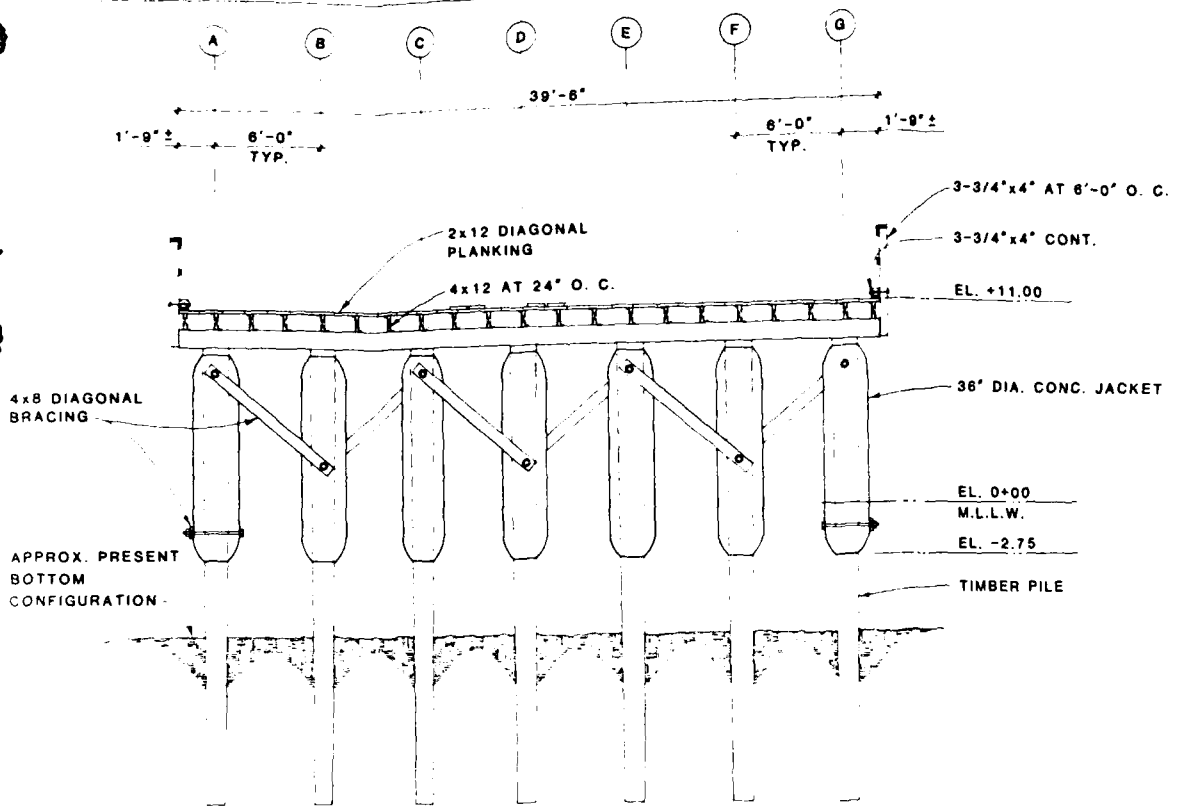
PLAN
1":20'



SECTION "A"
1/8":1'-0"

NOTES:

1. ○ INDICATES TIMBER PILE WITH PILE-GARD WRAP
2. ◎ INDICATES TIMBER PILE WITH CONC. JACKET



SECTION "A"
1/8":1'-0"

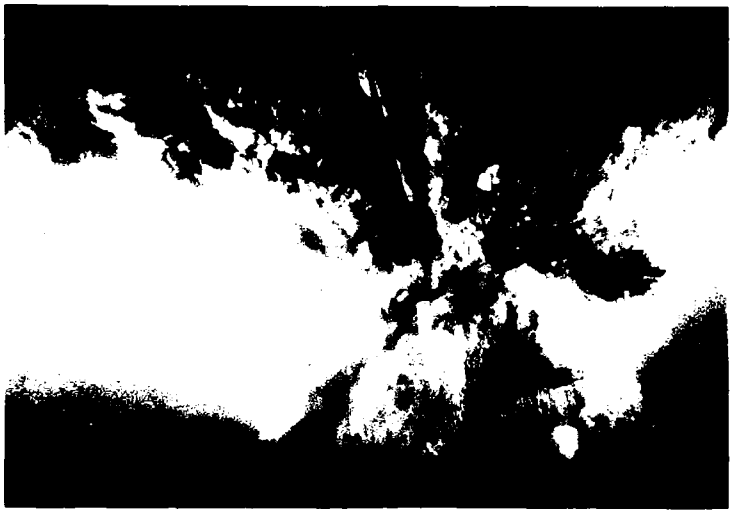
NOTES:

1. C INDICATES TIMBER PILE WITH PILE-GARD WRAP
2. Ō INDICATES TIMBER PILE WITH CONC. JACKET

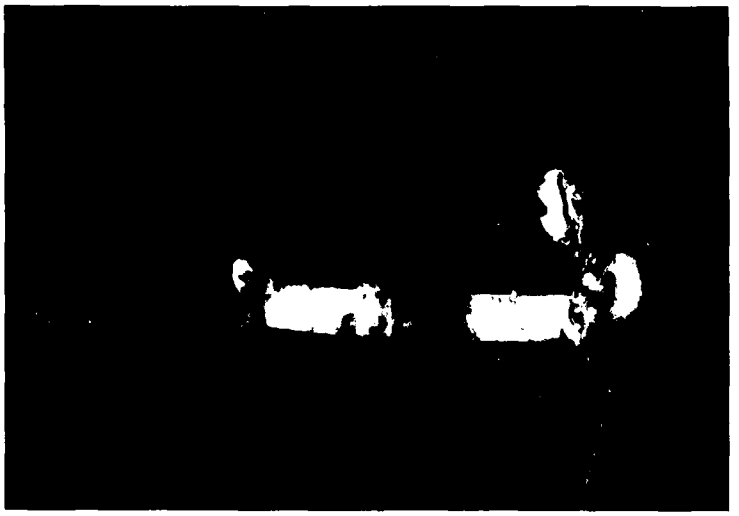
MARINA 1231, PIER 17 PLAN AND TYPICAL SECTION NAVAL AMPHIBIOUS BASE, CORONADO, CALIFORNIA		
Blaylock-Willis and Associates STRUCTURAL ENGINEERS SAN DIEGO, CALIFORNIA	DATE: NOV. 1984	FIG. 11

28. Marina, Pier 17. View is to the northeast of the fixed pier in the foreground with the floating piers beyond.

29. Marina, Pier 17. Picture shows the below deck support of the Pier. Wood piles (except C-7, C+-7, C-5, D-5, 1C, 1D, and 1E) are concrete jacketed with jackets outboard of line 2, short of the mudline.

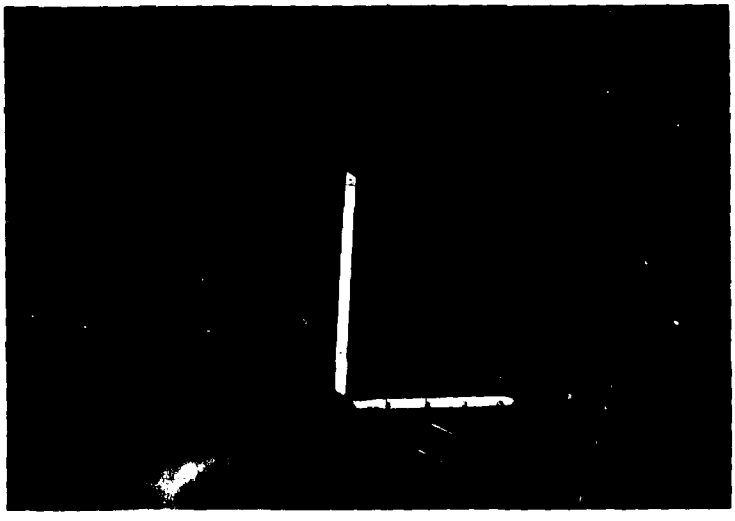


30. Marina, Pier 17, Pile F-6. Picture is taken at the bottom of the pile jacket showing exposed wooden pile below. The wood exhibits considerable limnoria damage.

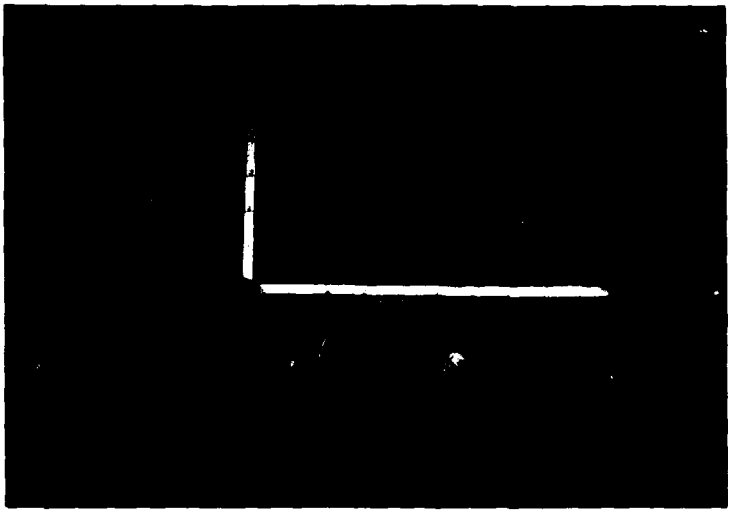


31. Marina, Pier 17, Pile C+-7. Picture is taken of bottom of the pile covering showing exposed wood pile below. The limnoria damage will continue in this area so long as it is exposed.

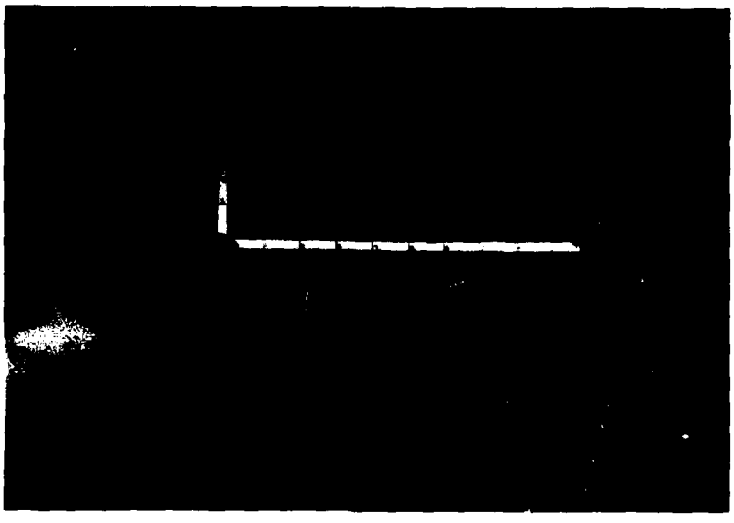
32. Marina, Float B, Pile 4. Picture is of the wooden pile at a large intrusion. The horizontal scale is touching the far side of the hole. The scale is 10 inches in length.



33. Marina, Float B, Pile 7. The pile is wooden. The horizontal depth of the intrusion is about 6 inches.



34. Marina, Float B, Pile 12-B. Picture is of cleaned strip at mid-height of concrete pile previous to picking with pointed hammer.



35. Marina, Float B, Pile 12-B. The spall at the right hand corner was made by six blows of a pointed hammer.

SECTION 5 - APPENDICES

5.1 PERSONNEL ON PROJECT

1. Chesapeake Division Personnel:
   Phillip Scola - Program Manager
   Christopher Crilley - EIT

2. Blaylock-Willis and Associates Personnel:
   A.J. Blaylock - Civil/Structural Engineer, Diver
   James Willis - Civil/Structural Engineer, Diver
   Daniel McNaughton - Civil/Structural Engineer, Diver
   Matthew Martinez - Civil Engineer, Diver
   Carson Creecy - Civil Engineer, Diver
   Thomas Spencer - Civil Engineer, Diver
   Darrell Williams - Structural Technician -Tender

3. Testing Engineers Inc. Personnel:
   Tony Rychell - Ultrasonic Equipment Technician

4. Studio B Photography Personnel:
   Lee Peterson - Underwater Photographer

5.2 TABLE OF STRUCTURAL ASSESSMENT

TABLE 5.1

RECORD OF STRUCTURAL ASSESSMENT

FUEL PIER

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
6B	Soft	-------	Soft	Bents 4 to 8 have gunite repairs. SE & NE corners have gunite repairs, some spalling.
7A	Firm	-------	Soft	Cracked with bleeding
7B	-------	-------	--------	SE & NE corners have gunite repairs. Some spalling.
9B	Firm	Soft	Firm	
12B	Soft	Soft	Soft	
13A	Firm	Firm	Firm	
16B	Soft	Soft	Soft	

TABLE 5.2

RECORD OF STRUCTURAL ASSESSMENT

PIER 1

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
5A	Firm	-------	Firm	Vertical crack @ N. face to mudline. Bleeding through gunite repair @ top of pile.
8B	Soft	-------	Firm	
11A	Firm	-------	Firm	
13B	Soft	-------	Soft	
15A	Firm	-------	Firm	
17A	-------	-------	--------	Vertical crack with bleeding @ south face
18B	Soft	-------	Firm	
19A	-------	-------	---------	Vertical crack with bleeding @ east face
19B	-------	-------	---------	Vertical crack with bleeding @ north face
21A	Firm	Firm	Firm	
22A	-------	-------	---------	Vertical crack with bleeding @ north face
24B	Soft	Firm	Soft	
24.9B Batter	-------	-------	---------	Fair
25B	-------	-------	---------	Good
25B.1 Batter	-------	-------	---------	Good

TABLE 5.2

RECORD OF STRUCTURAL ASSESSMENT

PIER 1

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
26A	-------	-------	---------	Good
26A.1 Batter	-------	-------	---------	Good
26.1A Batter	-------	-------	---------	Good

TABLE 5.3

RECORD OF STRUCTURAL ASSESSMENT

PIER 2

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
4B	--------	--------	---------	Vertical crack @ west face.
5A	Firm	--------	Firm	
8B	Firm	--------	Firm	
11A	Firm	--------	Firm	
13B	Firm	--------	Firm	
14B	---------	--------	---------	Vertical crack through a gunite repair.
15A	Firm	--------	Firm	
18B	Firm	--------	Firm	
21A	Firm	Firm	Firm	
23B	--------	--------	---------	Vertical crack with bleeding @ north face.
24B	Firm	Soft	Firm	Vertical crack with bleeding @ north face.
24.9B.1 Batter	-------	-------	---------	Good
25B Batter	-------	-------	---------	Bad
25B.1	-------	-------	---------	Good
26A	-------	-------	---------	Good

TABLE 5.3

RECORD OF STRUCTURAL ASSESSMENT

PIER 2

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
26A.1 Batter	-------	-------	---------	Good
26.1A Batter	-------	-------	---------	Good

TABLE 5.4

RECORD OF STRUCTURAL ASSESSMENT

PIER 3

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
5B	Firm	--------	Firm	Bent 2 - Repaired with gunite
8A	Firm	--------	Firm	Vertical crack @ north and west faces
9B	--------	--------	---------	Large spall (6" deep x 12" long) due to impact @ NE corner of bent, repaired but still cracked.
12B	Firm	--------	Firm	
13B	--------	--------	---------	Small spall with exposed reinforcing @ south face.
15A	Firm	--------	Firm	
18B	Firm	Firm	Firm	
19A	--------	-------	---------	Bleeding @ SW corner, north face & south face
20A	--------	-------	---------	Bleeding @ north & west faces through gunite repair
21A	Firm	Firm	Firm	
22A	--------	--------	---------	Vertical crack with bleeding @ NE corner & west face.
22B	--------	--------	---------	Vertical crack with bleeding @ NW corner
23A	--------	--------	---------	Horizontal cracks @ west face, 1' to 2' down. Slight bleeding @ bent.
24B	Firm	Firm	Firm	

TABLE 5.5

RECORD OF STRUCTURAL ASSESSMENT

PIER 4

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
5A	--------	--------	---------	Vertical crack with gunite repair @ south face.
5B	Firm	Firm	Firm	
6A	--------	--------	---------	Vertical crack with bleeding @ NE corner.
8A	Firm	Firm	Firm	
12B	Firm	Firm	Firm	
15A	Firm	Soft	Firm	
17B	--------	--------	---------	Epoxy repair with heavy bleeding @ NE corner.
18B	Firm	Firm	Firm	
21A	Firm	Firm	Firm	
21B	--------	--------	---------	Vertical crack @ north & south faces
24B	Firm	Firm	Firm	

TABLE 5.6

RECORD OF STRUCTURAL ASSESSMENT

PIER 5

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
3A	--------	--------	---------	Vertical crack @ NE corner. Spall @ SW corner of bent 3.
5B	Firm	--------	Firm	
6A	--------	--------	---------	Horizontal crack @ east face 1' below pile cap.
7A	--------	--------	---------	Horizontal crack @ east face, 1' below pile cap.
8A	Firm	Firm	Firm	Vertical crack with bleeding @ SE corner, north face & east face.
12B	Firm	--------	Firm	Spall with bleeding through repair @ top of pile.
15A	Firm	Firm	Firm	
17A	--------	--------	---------	Horizontal crack 1' below pile cap. Beam between Bents 16 & 17, spall due to impact
17B	--------	--------	---------	Vertical crack with bleeding through gunite repair.
18A	--------	--------	---------	Vertical crack with bleeding through gunite repair @ east face
18B	Firm	Soft	Firm	
20B	--------	--------	---------	
21A	Firm	Firm	Firm	
22A	--------	--------	---------	Vertical crack with bleeding through epoxy repair @ west face.
24B	Firm	Soft	Firm	Bleeding @ north face. Pile cap bleeding @ north & south corners @ Bents 22 & 23.

TABLE 5.7

RECORD OF STRUCTURAL ASSESSMENT

PIER 6

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
5B	Firm	Firm	Firm	
8A	Firm	Firm	Firm	
12B	Firm	Firm	Firm	Epoxy patch with bleeding @ Bent 9. Spall with bleeding @ north side of Bent 11.
15A	Firm	Firm	Firm	
17A	--------	---------	----------	Bleeding @ top of pile.
18B	Firm	Firm	Firm	Spall with bleeding @ beam between Bents 18 & 19.
21A	Firm	Firm	Firm	
21B	---------	---------	----------	Horizontal crack with bleeding @ NW corner.
24A	---------	---------	----------	Vertical crack with bleeding @ NE corner.
24B	Firm	Soft	Soft	

TABLE 5.8

RECORD OF STRUCTURAL ASSESSMENT

PIER 7

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
1B	--------	--------	----------	Vertical crack with bleeding through gunite @ north face.
3A	--------	--------	----------	Vertical crack with bleeding @ south & west faces.
3B	--------	--------	----------	Cracked & bleeding through gunite repair @ west face
4B	--------	--------	----------	Cracked & bleeding @ north face.
5B	Firm	--------	Firm	
8A	Firm	Firm	Firm	
8B	--------	--------	----------	Wire-mesh jacket bleeding through gunite repair.
11B	--------	--------	----------	Vertical crack with bleeding @ north & east faces.
12B	Firm	--------	Firm	
15A	Firm	Firm	Firm	
18A	--------	--------	----------	Vertical crack with bleeding through epoxy patch @ NE corner.
18B	Firm	Firm	Firm	
19B	--------	--------	----------	Horizontal crack @ south face.
20A	--------	--------	----------	Horizontal crack @ south face.
20B	--------	--------	----------	Wire-mesh jacket bleeding thrcugh gunite.

TABLE 5.8

RECORD OF STRUCTURAL ASSESSMENT

PIER 7

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
21A	Firm	Firm	Firm	
22A	--------	--------	---------	Vertical crack with bleeding @ west & south face.
22B	--------	--------	---------	Cracked & bleeding @ south & east faces.
23A	--------	--------	---------	Crack 1' below top.
23B	--------	--------	---------	Crack 1' below top.
24A	--------	--------	---------	Bleeding @ north & west faces
24B	Firm	Soft	Soft	Wire-mesh jacket bleeding through gunite.

TABLE 5.9

RECORD OF STRUCTURAL ASSESSMENT

PIER 8

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
5A	--------	---------	---------	Bleeding through gunite. Repair @ top of pile.
5B	--------	---------	Firm	Bleeding through gunite repair @ top of pile. Spall with exposed reinforcing @ beam between 6A & 7A.
8A	Firm	---------	Firm	Vertical crack with bleeding from 4' to 10' below bent @ north face.
9A	--------	---------	---------	Cracked and bleeding @ cap face.
12A	--------	---------	---------	Vertical crack @ west face.
12B	Firm	---------	Firm	
15A	Firm	Firm	Firm	Vertical crack with bleeding from 6' below bent to mudline @ north and west faces.
17A	--------	---------	----------	Gunite repair cracked and bleeding.
18A	--------	---------	----------	Horizontal crack.
18B	Firm	---------	Firm	Vertical crack from the bent to the mudline @ north face.
19B	---------	---------	----------	Vertical crack with bleeding @ SW corner.
20B	---------	---------	----------	Wire mesh exposed @ north face.
21A	Firm	Firm	Firm	
22B	--------	---------	----------	Wire mesh jacket bleeding through gunite.
24B	Firm	Firm	Firm	Wire mesh jacket bleeding through gunite.

TABLE 5.10

RECORD OF STRUCTURAL ASSESSMENT

PIER 9

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
1B	--------	---------	----------	Vertical crack with bleeding through epoxy repair @ east face.
3B	--------	---------	----------	Cracked and bleeding through gunite repair.
5B	Firm	---------	Firm	
8A	Firm	---------	Firm	
9B	--------	--- -----	----------	Spall @ NE corner.
10A	--------	---------	----------	Cracked and bleeding @ north & south faces.
10B	--------	---------	----------	Cracked and bleeding @ south face.
12B	Firm	---------	Firm	Bleeding through gunite repair @ south face.
15A	Firm	---------	Firm	Vertical crack from mudline to mid-height @ south face. Crack with bleeding @ SW corner.
15B	--------	---------	----------	Cracked and bleeding @ south face.
18B	Firm	---------	Firm	
19A	---------	---------	---------	Bleeding through gunite @ east face.
19B	---------	---------	----------	Vertical crack @ SW corner bleeding @ east face.
20B	---------	---------	----------	Bleeding through gunite @ west face.
21A	Firm	Firm	Firm	Vertical crack through gunite @ north & east faces.

TABLE 5.10

RECORD OF STRUCTURAL ASSESSMENT

PIER 9

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
21B	--------	---------	----------	Vertical crack @ north & west faces.
24A	--------	---------	----------	Horizontal crack @ south face.
24B	Firm	Firm	Soft	Horizontal crack @ south face. Crack along bent 24.

AD-A168 462 UNDERWATER FACILITIES INSPECTIONS AND ASSESSMENTS AT NAVAL AMPHIBIOUS BAS..(U) BLAYLOCK-WILLIS AND ASSOCIATES SAN DIEGO CA NOV 84 2/2

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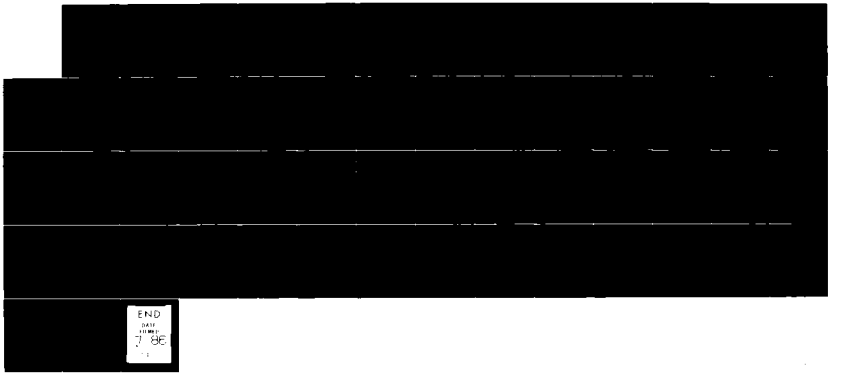

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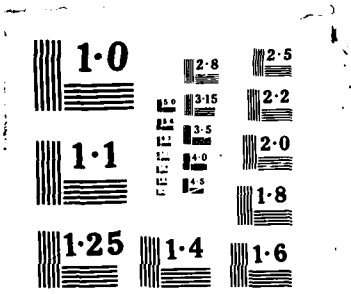
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TABLE 5.11

RECORD OF STRUCTURAL ASSESSMENT

PIER 10

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
1A	--------	--------	---------	Vertical crack with bleeding through gunite repair @ north face.
2B	--------	--------	---------	Vertical crack with bleeding through gunite repair @ east face.
3A	--------	--------	---------	Vertical crack with bleeding through gunite repair @ south face.
3B	--------	--------	---------	Vertical crack with bleeding through gunite repair @ NW corner.
4B	--------	--------	---------	Vertical crack with bleeding through gunite repair @ NE corner.
5A	--------	--------	---------	Vertical crack with bleeding @ north face.
5B	Firm	--------	Firm	
6B	--------	--------	---------	Vertical crack with bleeding @ east & west faces.
8A	Firm	Firm	Firm	
9B	--------	--------	---------	Small spall @ SE corner.
10B	--------	--------	---------	Bleeding through gunite repair @ north face.
11A	--------	--------	---------	Small crack @ north face.
12B	Firm	Firm	Firm	3" deep spall, 6' below pile cap @ NE corner.
13B	--------	---------	---------	Small spall @ east side of pile cap & south face of pile.
14A	--------	---------	---------	Vertical crack with bleeding @ south face.

TABLE 5.11

RECORD OF STRUCTURAL ASSESSMENT

PIER 10

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
15A	Firm	Firm	Firm	
16A	-------	---------	---------	Horizontal crack @ east face.
18A	-------	---------	---------	Vertical crack with bleeding @ north face.
18B	Firm	Firm	Firm	
19A	-------	---------	---------	Bleeding through gunite repair @ south face.
20A	-------	---------	---------	Horizontal crack @ south face.
21A	Firm	Firm	Firm	Vertical crack with bleeding @ west face.
22B	--------	---------	---------	Pile out of alignment (Dog-leg @ top of pile).
23A	--------	---------	---------	Vertical crack with bleeding @ south & west corners
24A	--------	---------	---------	New pile (driven through deck)
24B	Firm	Firm	Firm	Vertical crack with bleeding @ north face. Crack in beam between piles 23B & 24B.

TABLE 5.12

RECORD OF STRUCTURAL ASSESSMENT

PIER 11

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
1A	--------	---------	---------	Spall @ NE corner. Spall with exposed reinforcing @ deck between bents 2 & 3.
5B	Firm	---------	Firm	Vertical crack with bleeding @ NE corner.
8A	Firm	---------	Firm	
9B	--------	---------	----------	Bleeding @ bottom of pile cap.
10A	--------	---------	----------	Spall with bleeding through gunite repair @ north face.
12B	Firm	Firm	Firm	
13A	--------	---------	----------	Bleeding through gunite repair. Diagonal crack with bleeding @ north side of pile cap.
15A	Firm	Soft	Firm	
16A	---------	---------	----------	Spall with crack @ beam between piles 16A & 17A.
16B	---------	---------	----------	Vertical crack with bleeding @ SE corner & north face.
18B	Firm	Firm	Firm	Cracked with bleeding @ SE corner of pile cap.
21A	Firm	Firm	Firm	Heavy gunite repairs of beams between bents 17 to 24 @ Lines A & B.
21B	--------	---------	---------	Bleeding @ north face.
22A	--------	---------	---------	Large spall with bleeding @ beam between piles 21A & 22A.
24B	Firm	Firm	Firm	New pile @ 24A(driven through deck).

TABLE 5.13

RECORD OF STRUCTURAL ASSESSMENT

BRIDGE

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
7.4D	--------	---------	----------	Bleeding @ east face.
7.4E	--------	---------	----------	Bleeding @ east face.
7.5F	Firm	---------	Firm	
8.1D	--------	--------	---------	Bleeding @ east face.
8.1E	--------	---------	---------	Vertical crack @ north face.
8.1K	Firm	---------	Firm	
8.9C	--------	---------	----------	Crack with bleeding @ north face. Bleeding @ south face.
8.9D	Firm	---------	Firm	
8.9H	Firm	---------	Firm	Vertical crack with bleeding.

TABLE 5.14

RECORD OF STRUCTURAL ASSESSMENT

PIER 12

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
3A	--------	---------	----------	Vertical crack with bleeding @ west face.
3B	--------	---------	----------	Vertical crack with bleeding @ west face. Horizontal crack @ SE corner & south face.
5B	Firm	Firm	Firm	Vertical crack with bleeding through gunite.
7A	--------	---------	----------	Bleeding through gunite jacket.
8A	Firm	---------	Firm	
8B	---------	---------	----------	Vertical crack with bleeding @ SE corner.
10B	---------	---------	----------	Vertical crack with bleeding @ SE corner.
11A	---------	---------	----------	Horizontal crack with bleeding @ south face.
11B	---------	---------	----------	Vertical crack with bleeding through epoxy repair @ NE corner & south face.
12B	Firm	Firm	Firm	Horizontal crack with bleeding @ north face of pile 11B.
13A	--------	---------	----------	Vertical crack with bleeding @ south & west faces.
13B	--------	---------	---------	Spall @ NE corner of pile cap.
15A	Firm	Firm	Firm	
18B	Firm	Firm	Firm	Bleeding through gunite repair @ south face.
19B	---------	---------	----------	Wire mesh bleeding through gunite repair @ south & west faces.

TABLE 5.14

RECORD OF STRUCTURAL ASSESSMENT

PIER 12

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
21A	Firm	Firm	Firm	Vertical crack with bleeding @ west face.
22B	--------	---------	---------	Bleeding @ north face.
24B	Firm	Firm	Firm	

TABLE 5.15

RECORD OF STRUCTURAL ASSESSMENT

PIER 13

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
1B	--------	--------	---------	Bleeding through epoxy patch @ north face. Vertical cracks @ south & east faces.
4B	--------	--------	---------	Vertical crack with bleeding @ west face.
5B	Firm	Firm	Firm	
8A	Firm	--------	Firm	Bleeding through gunite @ east face.
9B	--------	--------	---------	Horizontal cracks with bleeding through epoxy repair @ south & west faces.
12B	Firm	Firm	Firm	
13B	--------	--------	---------	Crack with bleeding through epoxy repair @ east face.
15A	Firm	Firm	Firm	
15B	---------	---------	---------	Vertical crack with bleeding @ south face.
17B	---------	---------	---------	Vertical crack with bleeding @ west face.
18B	Firm	Firm	Firm	
19B	---------	---------	---------	Vertical crack with bleeding through gunite repair @ east face.
20A	---------	---------	---------	Cracked with bleeding through gunite repair @ north & east faces.
21A	Firm	Firm	Firm	Bleeding through gunite @ east face.
23B	---------	---------	---------	Horizontal crack @ north face.

TABLE 5.15

RECORD OF STRUCTURAL ASSESSMENT

PIER 13

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
24A	---	---	---	New 18" octagonal pile.
24B	Firm	Firm	Firm	New 18" octagonal pile. Spall @ top of pile due to driving.
Bent 23 to 24	---	---	---	The concrete slab and beams outboard (towards bent 24) of bent 23 appear to be new.
Bent 23 to 24	---	---	---	Cracking, spalling and bleeding @ beam between piles 23B & 24B. Cracking @ beam between piles 23A & 24A.

TABLE 5.16

RECORD OF STRUCTURAL ASSESSMENT

PIER *14*

DESCRIPTION OF PILE CONDITION				
PILE	**TOP**	**MIDDLE**	**BOTTOM**	**STRUCTURAL COMMENTS**
2A	---------	---------	----------	Vertical crack with bleeding @ north face.
2B	---------	---------	----------	Vertical crack with bleeding @ north face.
3A	---------	---------	----------	Vertical crack with bleeding through gunite @ south face.
4A	---------	---------	----------	Vertical crack with bleeding @ south face.
4B	---------	---------	----------	Bleeding through gunite repair @ south face.
5B	Firm	---------	Firm	Vertical crack with bleeding @ beam between piles 6B & 7B.
6B	---------	---------	----------	Vertical crack with bleeding @ north face.
8A	Firm	---------	Firm	
10A	---------	---------	----------	Vertical crack with bleeding through gunite repair @ west face.
11B	---------	----------	----------	Vertical crack with bleeding @ north face.
12B	Firm	---------	Firm	
13A	---------	---------	----------	Vertical crack with bleeding @ east face.
14A	---------	---------	----------	Vertical crack with bleeding @ west face.
15A	Firm	---------	Firm	Vertical crack with bleeding through gunite repair @ north face.
18A	----------	---------	----------	Horizontal crack with bleeding @ north face.

TABLE 5.16

RECORD OF STRUCTURAL ASSESSMENT

PIER 14

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
18B	Firm	Firm	Firm	
21A	Firm	Firm	Firm	
24A	---------	---------	---------	26" square by 4' long concrete jacket @ top of pile.
24B	Firm	Firm	Firm	

TABLE 5.17

RECORD OF STRUCTURAL ASSESSMENT

PIER 15

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
Bents 1 to 2	---	---	---	Vertical crack @ beam between bents 1 & 2.
Bent 2	---	---	---	Horizontal crack with bleeding and exposed reinforcing @ bent 2.
3A	---	---	---	Vertical crack with bleeding @ east face.
Bent 4	---	---	---	Spall with exposed reinforcing @ bent 4.
5B	Firm	---	Firm	Spalling at bottom of deck between bents 4 & 5.
7A	---	---	---	Vertical crack with bleeding @ east face.
8A	Firm	---	Firm	
9A	---	---	---	Crack with bleeding @ north face.
10A	---	---	---	Crack with bleeding @ bottom of pile cap.
Bent 10 to 11	---	---	---	Horizontal crack with bleeding through gunite @ beam between bents 10 & 11.
12B	Firm	---	Firm	Crack with bleeding @ bent 11.
13A	---	---	---	Crack with bleeding @ south & west faces.
14A	---	---	---	Crack with bleeding @ bottom of pile cap.
14B	---	---	---	Horizontal crack with exposed reinforcing @ beam between piles 14B & 15B.
15A	Firm	Soft	Firm	Horizontal crack with bleeding @ bent 15.

TABLE 5.17

RECORD OF STRUCTURAL ASSESSMENT

PIER 15

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
15B	---------	--------	---------	Horizontal crack with bleeding @ beam between piles 15B & 16B.
18A	Firm	--------	Firm	Crack with bleeding @ SW corner and west face.
18B	--------	--------	---------	Diagonal crack with spall @ NE corner @ pile 18A.
20A	--------	--------	---------	Vertical crack with bleeding @ north face. Crack with bleeding @ bottom of pile cap.
21A	Firm	Firm	Firm	Vertical crack with bleeding @ west face.
22A	---------	---------	---------	Vertical crack with bleeding @ north & east faces.
Bent 23 to 24	---------	---------	---------	Crack at bottom side of deck between bents 23 & 24.
Bent 23 to 24	---------	---------	---------	Bleeding through gunite between bents 23 & 24.
Bent 24	---------	---------	---------	Bleeding at bottom of bent 24.
24B	Firm	Firm	Firm	Horizontal crack with bleeding @ north face.

TABLE 5.18

RECORD OF STRUCTURAL ASSESSMENT

MAMMAL PIER

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
2B	---	---	---	Two vertical cracks at beam between piles 2B & 3B.
2D	---	---	---	Horizontal crack at inside face of beam between piles 2D & 3D.
3B Batter	---	---	---	Bleeding @ top of pile.
5B	---	---	---	Horizontal crack @ north face.
5D	Firm	---	Firm	
6B	Firm	---	Firm	
6D	---	---	---	4' horizontal crack at beam between piles 6D & 7D.
7D	---	---	---	Vertical crack @ north & east faces.
8B	Firm	Firm	Firm	
8C	---	---	---	Vertical crack @ each face.
9C	---	---	---	Vertical crack @ south face. Crack at bottom of beam.
10C	---	---	---	Vertical crack @ east & west faces. Spall at bottom of beam.
11C	Firm	Firm	Firm	Vertical crack @ each face.
12C	---	---	---	Vertical crack @ west face. Crack at bottom of beam.
13C	---	---	---	Vertical crack @ south & west faces.

TABLE 5.18

RECORD OF STRUCTURAL ASSESSMENT

MAMMAL PIER

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
14A	---	---	---	Crack at pile cap. Bleeding @ beam between piles 14A & 15A.
14C	---	---	---	Crack at top of pile. 2 cracks with bleeding @ beam between piles 14C & 15C.
14E	---	---	---	Vertical crack at pile cap. Horizontal crack @ beam between piles 14E & 15E.
15C	---	---	---	Crack at top of pile. Crack at pile cap.
15E	---	---	---	Bleeding at top of pile. 2-4' horizontal cracks @ beam.
16A	---	---	---	4 cracks at beam between piles 16A & 17A.
16C	Firm	Firm	Firm	Crack at top of pile. Bleeding @ pile cap. 12 cracks at beam between piles 16C & 17C.
16E	---	---	---	Bleeding at pile cap. 10 cracks at beam between piles 16E & 17E.
17A	---	---	---	8 cracks at beam between piles 17A & 18A.
17C	---	---	---	2 cracks at pile cap. 11 cracks @ beam between piles 17C & 18C.
17E	Firm	Firm	Firm	Bleeding with exposed reinforcing @ pile cap.
Bent 16E to 18E	---	---	---	2 Horizontal cracks from midspan between 16E & 17E to 18E.
Bent 17E to 18E	---	---	---	7 cracks @ beam between piles 17E & 18E.
18A	---	---	---	Crack @ pile cap. 8 cracks @ beam between piles 17A & 18A.
18A Batter	Firm	Firm	Firm	2 cracks @ beam between piles 18A & 18C.

TABLE 5.18

RECORD OF STRUCTURAL ASSESSMENT

MAMMAL PIER

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
18C	---	---	---	3' horizontal crack @ beam between piles 17C & 18C.
Bent 18C to 18E	---	---	---	Horizontal crack @ beam between piles 17C & 18C.
Bent 18C to 18E	---	---	---	Spall @ beam between piles 17C & 18C.
18E	---	---	---	Bleeding @ pile cap. 3 cracks @ beam between piles 18C & 18E.

TABLE 5.19

RECORD OF STRUCTURAL ASSESSMENT

BULKHEAD NO. 1

DESCRIPTION OF QUAYWALL CONDITION					
QUAYWALL		TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
Station	Type				
0+00	Concrete	-------	------	Firm	
2+00	Concrete	-------	------	Firm	
3+11	Concrete	-------	------	-------	Covered with concrete rubble rip-rap.
5+11	Concrete	-------	------	Firm	Grout at bottom of some joints
7+11	Concrete	-------	------	Firm	Moderate leakage
9+11	Concrete	-------	------	Firm	Occasional cracks with bleeding
11+11	Concrete	-------	------	Firm	Numerous cracks with bleeding
13+11	Concrete	-------	------	Firm	Numerous cracks with bleeding
15+11	Concrete	-------	------	Firm	Occasional cracks with bleeding. Spall with exposed reinforcing.
17+11	Concrete	-------	------	Firm	Intermittent cracks with bleeding. Large crack with bleeding.
19+11	Concrete	-------	------	Firm	Occasional cracks with bleeding
21+11	Concrete	-------	------	Firm	Occasional cracks with bleeding
23+11	Concrete	-------	------	Firm	Occasional cracks with bleeding. Some with gunite repairs.
24+11	Concrete	-------	------	-------	Horizontal crack with bleeding @ pile cap between Stations 92+00 & 93+00

TABLE 5.19

RECORD OF STRUCTURAL ASSESSMENT

BULKHEAD NO. 1

DESCRIPTION OF QUAYWALL CONDITION					
QUAYWALL		TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
Station	Type				
25+11	Concrete	--------	-------	Firm	Intermittent cracks with bleeding
25+81	Concrete	--------	-------	--------	Horizontal crack with bleeding @ pile cap between stations 94+20 & 94+70
26+27	Concrete	--------	-------	--------	Broken pile cap & sheet pile
27+11	Concrete	--------	-------	--------	Badly spalled and/or broken pile cap between stations 95+00 & 96+00
27+11	Concrete	--------	-------	--------	Some exposed reinforcing between stations 95+00 & 96+00
27+11	Concrete	--------	-------	Firm	Numerous cracks with bleeding
27+41	Concrete	--------	-------	--------	Large crack with exposed reinforcing
28+89	Concrete	--------	-------	--------	Large crack with exposed reinforcing
29+11	Concrete	--------	-------	Firm	Numerous cracks with bleeding
30+86	Concrete	--------	-------	--------	Spalling with exposed reinforcing
32+22	Concrete	--------	-------	Firm	Numerous cracks with bleeding through gunite repairs
32+22	Concrete	--------	-------	--------	Tie-back wall from station 99+00 to station 101+11

Note: There is a horizontal crack with bleeding at the pile cap under Piers 1,5,6,10,12,13 and the Fuel Pier.

TABLE 5.20

RECORD OF STRUCTURAL ASSESSMENT

BULKHEAD NO. 2

DESCRIPTION OF QUAYWALL CONDITION					
QUAYWALL		TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
Station	Type				
0+00	Concrete	--------	-------	--------	Station 0+00 equals station 30+86 per Bulkhead No. 1
2+00	Concrete	--------	-------	Firm	Occasional cracks with bleeding. Tie-backs stop north of Pier 16.
4+00	Concrete	--------	-------	Firm	Numerous cracks with bleeding. Some gunite repairs.
6+00	Concrete	--------	-------	--------	Horizontal crack with bleeding @ pile cap between Station 4+00 & 6+00
6+00	Concrete	--------	-------	Firm	Numerous cracks with bleeding. Some gunite repairs.
8+00	Concrete	--------	-------	Firm	Occasional cracks with bleeding
10+00	Concrete	--------	-------	Firm	Occasional gunite repairs
12+00	Concrete	--------	-------	Firm	Occasional gunite repairs
14+00	Concrete	--------	-------	Firm	Occasional gunite repairs
14+35	Concrete	--------	-------	Firm	Occasional gunite repairs

TABLE 5.21

RECORD OF STRUCTURAL ASSESSMENT

NAB MARINA
PIER 17

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
1C	--------	-------	---------	Pile-gard wrap to mudline
1D	--------	-------	---------	Pile-gard wrap to mudline
1E	--------	-------	---------	Pile-gard wrap to mudline
2C	--------	-------	---------	Concrete jacket to mudline
2D	--------	-------	---------	Concrete jacket to mudline
2E	--------	-------	---------	Concrete jacket to mudline
3C	--------	-------	---------	Concrete jacket to mudline
3D	--------	-------	---------	Concrete jacket to mudline
3E	--------	-------	---------	Concrete jacket to mudline
4C	--------	-------	Good	Concrete jacket, Pile exposed below
4D	--------	-------	Good	Concrete jacket, Pile exposed below
4E	--------	-------	Good	Concrete jacket, Pile exposed below
5A	--------	-------	Good	Concrete jacket, Pile exposed below
5B	--------	-------	Good	Concrete jacket, Pile exposed below
5C	--------	-------	Good	Pile-gard wrap, Pile exposed below

TABLE 5.21

RECORD OF STRUCTURAL ASSESSMENT

NAB MARINA
PIER 17

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
5D	---------	--------	Good	Pile-gard wrap, Pile exposed below
5E	---------	--------	Good	Concrete jacket, Pile exposed below
5F	---------	--------	Good	Concrete jacket, Pile exposed below
5G	---------	--------	Good	Concrete jacket, Pile exposed below
6A	---------	--------	Good	Concrete jacket, Pile exposed below
6B	---------	--------	Bad	Concrete jacket, Pile exposed below
6C	---------	--------	Good	Concrete jacket, Pile exposed below
6D	---------	--------	Good	Concrete jacket, Pile exposed below
6E	---------	--------	Good	Concrete jacket, Pile exposed below
6F	---------	--------	Good	Concrete jacket, Pile exposed below
6G	---------	--------	Good	Concrete jacket, Pile exposed below
7A	---------	--------	Good	Concrete jacket, Pile exposed below
7B	---------	--------	Fair	Concrete jacket, Pile exposed below
7C	---------	--------	Good	Pile-gard wrap, Pile exposed below
7D-C	---------	--------	Good	Pile-gard wrap, Pile exposed below

TABLE 5.21

RECORD OF STRUCTURAL ASSESSMENT

NAB MARINA
PIER 17

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
7D-E	---------	--------	Fair	Concrete jacket, Pile exposed below
7E	---------	--------	Fair	Concrete jacket, Pile exposed below
7F	---------	--------	Fair	Concrete jacket, Pile exposed below
7G	---------	--------	Fair	Concrete jacket, Pile exposed below

TABLE 5.21

RECORD OF STRUCTURAL ASSESSMENT

NAB MARINA
FLOAT A

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
1	---	---	---	Good
2	---	---	---	Good
3	---	---	---	Good
4	---	---	---	Good
5	---	---	---	Fair
6	---	---	---	Bad
7	---	---	---	Bad
8	---	---	---	Bad
9	---	---	---	Good
10	---	---	---	Bad
11	---	---	---	Good
12	Bad	Good	Good	
13	---	---	---	Good
14	---	---	---	Good
15	---	---	---	Fair

TABLE 5.21

RECORD OF STRUCTURAL ASSESSMENT

NAB MARINA
FLOAT A

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
16	---------	--------	--------	Good
17	---------	--------	--------	Good

TABLE 5.21

RECORD OF STRUCTURAL ASSESSMENT

NAB MARINA
FLOAT B

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
1	----------	----------	----------	Good
2	----------	----------	----------	Good
3	----------	----------	----------	Good
4	----------	----------	----------	Bad
5B	Firm	Firm	Firm	
7	----------	----------	----------	Fair
8A	Firm	Firm	Firm	
9B	----------	----------	----------	Vertical crack (12') @ south face
10B	----------	----------	----------	Vertical crack with bleeding @ each face
11	----------	----------	----------	Bad
12B	Firm	Firm	Firm	
13	----------	----------	----------	Bad
15	----------	----------	----------	Bad
16B	----------	----------	----------	Fair
17	----------	----------	----------	Good

TABLE 5.21

RECORD OF STRUCTURAL ASSESSMENT

NAB MARINA
FLOAT B

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
18	----------	--------	--------	Good
20	----------	--------	--------	Good

TABLE 5.21

RECORD OF STRUCTURAL ASSESSMENT

NAB MARINA
FLOAT C

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
1A	Firm	Firm	Firm	
2	Firm	Firm	Firm	
7	Firm	Firm	Firm	
11	Firm	Firm	Firm	
14B	Firm	Firm	Firm	
16A	Firm	Firm	Firm	
20A	Firm	Firm	Firm	
22B	Firm	Firm	Firm	

TABLE 5.21

RECORD OF STRUCTURAL ASSESSMENT

NAB MARINA
FLOAT D

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
1	---------	--------	--------	Bad
2	---------	--------	--------	Good
3A	---------	--------	--------	Good
3B	Poor	Good	Good	
4	---------	--------	--------	Good
5A	---------	--------	--------	Good
5B	---------	--------	--------	Good
6	---------	--------	--------	Good
7A	---------	--------	--------	Bad
7B	---------	--------	--------	Good
8	---------	--------	--------	Good
9A	Bad	Good	Good	
9B	---------	--------	--------	Good
10A	---------	--------	--------	Good
10B	---------	--------	--------	Good

TABLE 5.21

RECORD OF STRUCTURAL ASSESSMENT

NAB MARINA
FLOAT D

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
11A	---------	--------	--------	Bad
11B	---------	--------	--------	Good
12A	---------	--------	--------	Good
12B	---------	--------	--------	Good
13A	---------	--------	--------	Poor
13B	Good	Bad	Good	
14A	---------	--------	--------	Poor
14B	---------	--------	--------	Fair
15A	---------	--------	--------	Bad
15B	---------	--------	--------	Good
16A	---------	--------	--------	Fair
16B	---------	--------	--------	Good

TABLE 5.21

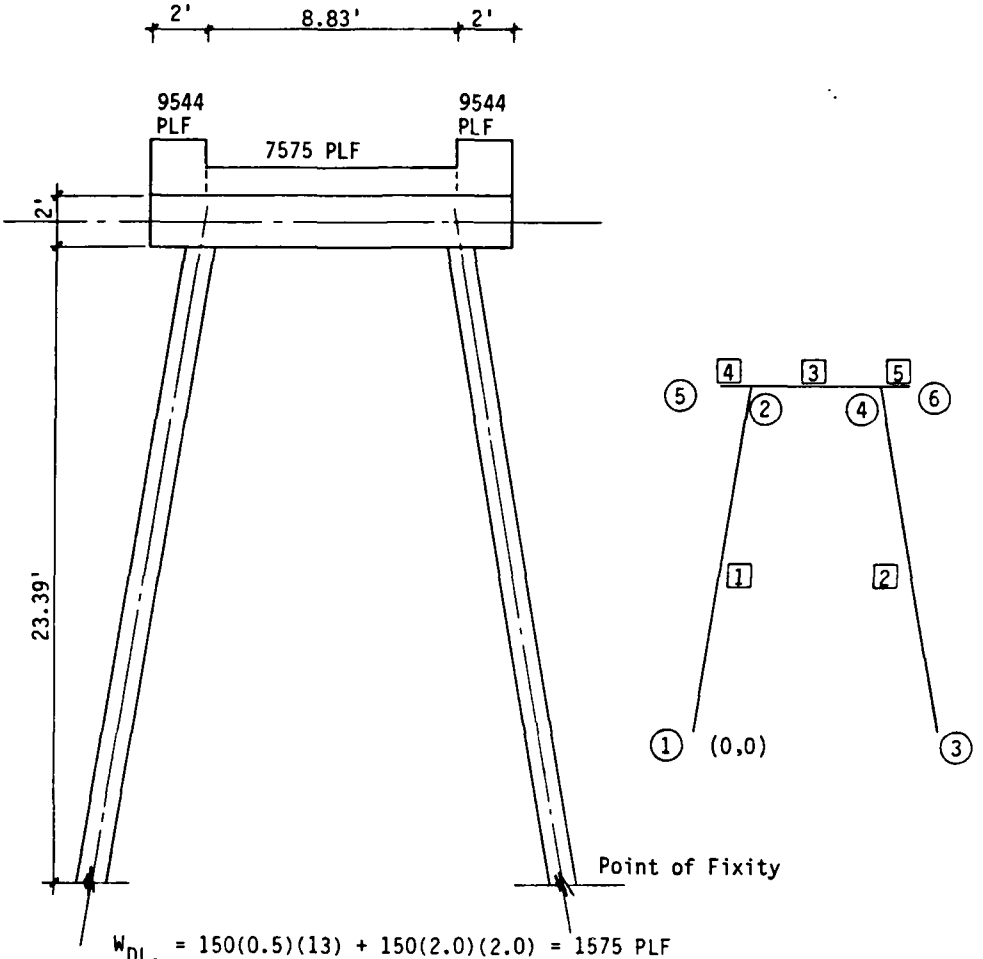
RECORD OF STRUCTURAL ASSESSMENT

NAB MARINA
FLOAT E

DESCRIPTION OF PILE CONDITION				
PILE	TOP	MIDDLE	BOTTOM	STRUCTURAL COMMENTS
1	---------	--------	--------	Bad
2	---------	--------	--------	Good
3	Fair	Good	Good	
4	--------	--------	--------	Fair
5	--------	--------	--------	Bad
6	--------	--------	--------	Bad
7	Fair	Fair	Fair	
8	--------	--------	--------	Good

5.3 CALCULATIONS

FRAME ANALYSIS & LOADS



W_{DL_1} = 150(0.5)(13) + 150(2.0)(2.0) = 1575 PLF

$W_{DL_2} = \frac{150(0.5)(1.25)(15)(2) + 150(0.5)(1.0)(15)}{2.0}$ = 1969 PLF

W_{LL} = 400 (15) = 6000 PLF

```
*************************************************************************

        CALCULATE FRAME AXIAL FORCES AND MOMENTS FOR
        DEAD LOAD, LIVE LOAD AND DEAD PLUS LIVE LOADS;
        TO DETERMINE THE MAXIMUM ALLOWABLE LIVE LOAD
        CAPACITY OF THE PIER FOR THE CRITICAL PILE

*************************************************************************

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*** SYSTEMS PROFESSIONAL STRESS - PROGRAM NO. 16.1 REV-2030.G1 ***

*************************************************************************

STRUCTURE - TYPICAL BENT - PIERS 1 THRU 15
TYPE PLANE FRAME
NUMB OF JOINTS 6 $ TRACE
NUMB OF MEMB 5 $ NUMB OF LOADS 3
NUMB OF SUPPORTS 2
TABU FORCES REACTIONS DISPLACEMENTS
UNITS KIPS FEET
JOINT COOR
1 0 0 S $ 2 4.83 30.0 $ 3 18.49 0 S
4 13.66 30.0 $ 5 2.83 30.0 F $ 6 15.66 30.0 F
UNITS KIPS INCHES
MEMB PROP PRIS AX 256.0 IZ 5461.0 * 16 X 16 PILE
1$2
MEMB PROP PRIS AX 360.0 IZ 6750.0 * BEAM CAP
3 THRU 5
MEMB INCI
1 1 2 $ 2 3 4 $ 3 2 4 $ 4 5 2 $ 5 4 6
CONST E 3644. ALL BUT 3122. 3 4 5
UNITS KIPS FEET
LOADING NO 1 - DEAD LOAD
MEMBER LOADS
3 FORCE X UNIFORM -1.58
3 FORCE Y UNIFORM -3.54 $ 5
JOINT LOADS
2 FORCE Y -5.49 $ 4
LOADING NO 2 - LIVE LOAD
MEMBER LOADS
3 FORCE Y UNIFORM -6.00 $ 4 $ 5
LOADING NO 3 - DEAD + LIVE
COMBINE 1 1.4 2 1.7
SOLVE
PROBLEM CORRECTLY SPECIFIED. EXECUTION TO PROCEED
```

STRUCTURE = TYPICAL BENT - PIERS 1 THRU 15

(UNITS IN FEET AND KIPS)

LOADING NO 1 - DEAD LOAD

MEMBER FORCES

MEMBER	JOINT	AXIAL FORCE	SHEAR FORCE	MOMENT
1	1	19.806	-0.051	-0.48
	2	-19.806	0.051	-1.06
2	3	19.806	0.051	0.48
	4	-19.806	-0.051	1.06
3	2	3.198	6.976	8.14
	4	-3.198	6.976	-8.14
4	5	0.000	0.000	0.00
	2	-0.000	7.000	-7.00
5	4	-0.000	7.000	7.00
	6	0.000	-0.000	0.00

APPLIED JOINT LOADS - FREE JOINTS

JOINT	FORCE X	FORCE Y	MOMENT Z
2	-0.000	-5.490	0.00
4	0.000	-5.490	0.00
5	0.000	0.000	0.00
6	0.000	-0.000	0.00

REACTIONS/APPLIED LOADS SUPPORT JOINTS

JOINT	FORCE X	FORCE Y	MOMENT Z
1	3.198	13.545	-0.48
3	-3.198	19.546	0.48
SUM	-0.000	35.091	

FREE JOINT DISPLACEMENTS

JOINT	X-DISPLACEMENT	Y-DISPLACEMENT	ROTATION
2	0.0300	-0.0007	-0.0001
4	-0.0300	-0.0007	0.0001
5	0.0000	-0.0005	-0.0000
6	-0.0000	-0.0005	0.0000

STRUCTURE - TYPICAL BENT — PIERS 1 THRU 15

(UNITS IN FEET AND KIPS)

LOADING NO 2 - LIVE LOAD

MEMBER FORCES

MEMBER	JOINT	AXIAL FORCE	SHEAR FORCE	MOMENT
1	1	39.060	-0.462	-4.61
	2	-39.060	0.462	-9.43
2	3	-39.060	-0.462	4.61
	4	-39.060	-0.462	9.43
3	2	6.665	26.490	21.43
	4	-6.665	26.490	-21.43
4	5	0.000	0.000	0.00
	2	0.000	12.000	-12.00
5	4	-0.000	12.000	12.00
	6	0.000	0.000	-0.00

APPLIED JOINT LOADS, FREE JOINTS

JOINT	FORCE X	FORCE Y	MOMENT Z
2	0.000	-0.000	-0.00
4	-0.000	-0.000	0.00
5	0.000	0.000	0.00
6	0.000	0.000	-0.00

REACTIONS, APPLIED LOADS SUPPORT JOINTS

JOINT	FORCE X	FORCE Y	MOMENT Z
1	6.665	38.490	-4.61
3	-6.665	38.490	4.61
SUM	-0.000	76.980	

FREE JOINT DISPLACEMENTS

JOINT	X-DISPLACEMENT	Y-DISPLACEMENT	ROTATION
2	0.0000	-0.0013	-0.0005
4	-0.0000	-0.0013	0.0005
5	0.0000	-0.0003	-0.0005
6	-0.0000	-0.0003	0.0005

STRUCTURE - TYPICAL BENT - PIERS 1 THRU 15

(UNITS IN FEET AND KIPS)

LOADING NO 3 - DEAD + LIVE

MEMBER FORCES

MEMBER	JOINT	AXIAL FORCE	SHEAR FORCE	MOMENT
1	1	94.130	-0.856	-8.51
	2	-94.130	0.856	-17.51
2	3	94.130	0.856	8.51
	4	-94.130	-0.856	17.51
3	2	15.808	54.799	47.82
	4	-15.808	54.799	-47.82
4	5	0.000	0.000	0.00
	2	-0.000	30.312	-30.31
5	4	-0.000	30.312	30.31
	6	0.000	0.000	-0.00

APPLIED JOINT LOADS, FREE JOINTS

JOINT	FORCE X	FORCE Y	MOMENT Z
2	0.000	-7.687	0.00
4	-0.000	-7.686	0.00
5	0.000	0.000	0.00
6	0.000	0.000	-0.00

REACTIONS, APPLIED LOADS SUPPORT JOINTS

JOINT	FORCE X	FORCE Y	MOMENT Z
1	15.808	92.797	-8.51
3	-15.808	92.797	8.51
SUM	-0.000	185.594	

FREE JOINT DISPLACEMENTS

JOINT	X-DISPLACEMENT	Y-DISPLACEMENT	ROTATION
2	0.0001	-0.0031	-0.0010
4	-0.0001	-0.0031	0.0010
5	0.0001	-0.0013	-0.0009
6	-0.0001	-0.0013	0.0009

DETERMINE MAXIMUM LIVE LOAD

A. Dead Plus Live

Column Reduction Factor Ref: Commentary ACI 318-83 10.11.7

Modified R Method

$R = 1.07 - 000.8\ lu/r \leq 1.0$
$R = 1.07 - 0.008(23.2)(\bar{I}2)/4.8 = 0.60$

DL - P_{DL} = 19.81 k M_{DL} = 1.06 ft-k
LL - P_{LL} = 39.06 k M_{LL} = 9.43 ft-k (400 psf live load)

For interaction diagram

$$P_u = \frac{1.4D+1.7L}{R} = \frac{1.4(19.81)+1.7(39.06)(LL/400)}{0.60}$$

$$= 46.22 + 0.277LL$$

$$M_u = \frac{1.4D+1.7L}{R} = \frac{1.4(1.06)+1.7(9.43)(LL/400)}{0.60}$$

$$= 2.47 + 0.067\ LL$$

so

LL (PSF)	P_u (k)	M_u (ft-k)	Interaction Diagram
400	157.0	29.3	OK
600	212.4	42.7	OK
800	267.8	56.1	OK
1000	323.2	69.5	OK
1200	378.6	82.9	OK
1400	434.0	96.3	OK
1600	489.4	109.7	NG
1800	544.8	123.1	NG
2000	600.2	136.5	NG

Maximum Live Load - 1400 psf

DEAD + LIVE ONLY

CHECK PILE CAPACITIES

FIND EMBEDMENT DEPTH FOR FIXITY — DM25.6-4

$E = 3644$ ksi $\quad I = 5461$ in.^{4} $\quad n_h = 45$ lb/in.^{3}

$$d = 1.8\sqrt[5]{\frac{EI}{n_h}} = 1.8\left(\frac{3.605\times10^6\times5461}{45}\right)^{1/5}$$

$d = 96" = 8'\text{-}0"$

PILE LENGTHS

PILES	BENT	LENGTH 'L'(ft)	DEPTH d (ft)	d + L (ft)	RIGIDITY $I/L^3\times10^{-3}$	$\Sigma I/L^3$
2	24	18.75	8.0	26.75	0.165	0.330
2	23	18.42	8.0	26.42	0.171	0.343
2	22	18.09	8.0	26.09	0.178	0.356
2	21	17.75	8.0	25.75	0.185	0.370
2	20	17.08	8.0	25.08	0.200	0.401
2	19	16.41	8.0	24.41	0.217	0.435
2	18	15.75	8.0	23.75	0.236	0.472
2	17	15.58	8.0	23.58	0.241	0.482
2	16	15.41	8.0	23.41	0.246	0.493
2	15	15.25	8.0	23.25	0.252	0.503
2	14	14.63	8.0	22.63	0.273	0.545
2	13	14.00	8.0	22.00	0.297	0.594
2	12	13.38	8.0	21.38	0.323	0.647
2	11	12.75	8.0	20.75	0.354	0.708
2	10	12.50	8.0	20.50	0.367	0.734
30						Σ 7.413

$$I/L^3 \text{ (AVE)} = \frac{7.413\times10^{-3}}{30} = 0.247\times10^{-3}$$

L (AVE) = 23.39 ft.

SEISMIC FORCES Ref: DM25.1, AASHTO 1977

PERIOD

$\Delta = \frac{PL^3}{12EI}$ $P = 1.0$ k
$I/L^3 = 0.247 \times 10^{-3}$ in.
$E = 3644$ ksi

$\Delta = 0.0925$ in

$k = \frac{V}{\Delta} = \frac{1.0 \text{ k}}{0.0925 \text{ in}} = 10.805$ k/in.

$T = 2\pi\sqrt{\frac{W}{gk}} = 2\pi\sqrt{\frac{39.0 \text{ k}}{386 \text{ in/s}^2 \ (10.805 \text{ k/in.})}}$

$T = 0.607$ sec

WEIGHT

$W = [0.5(4(1.25)+2(1)+12.83(1))(15)$
$+1.04(1.17)(13)(2)+1.5(2)(12.83)+11.7(1.33)^2(2)]150$

$W = 39036$ lb

$W = DL+25\%LL = 39.0+0.4(12.83)(15)(0.25) = 58.2$ k

SEISMIC FORCE Ref: AASHTO 1977

EQ= C.F.W.

$F = 1.0$ $W = 44.3$ k
$C = 0.16$ - Fig 1.2.20B @ $T = 0.6$s & $A = 0.5$g

EQ= $0.16(1.0)\ W = 0.16W$

EQ= $0.16(58.2) = 9.32$k

SLENDERNESS EFFECTS Ref: ACI 318-83

L = 23.39 ft. k = 0.8 l_u = 0.8 (23.39) = 18.71 ft.

r = 0.3d = 0.3(16 in.) = 4.8 in.

R = 1.07 - 0.008 l_u/r

$$R = 1.07 - \frac{0.008(18.71)(12)}{4.8} = \underline{0.70}$$

GRAVITY LOADS

$$LL = \frac{400 \text{ psf} \times 8.83 \text{ ft.} \times 15 \text{ ft.}}{1000 \text{ lb/k}} = 53 \text{ k} \times 1.7 = 90.1 \text{ k}$$

DL = = 39 k x 1.4 = 54.6 k

= 92 k 144.7 k

P_u = 144.7/2 = 72.4 k/pile

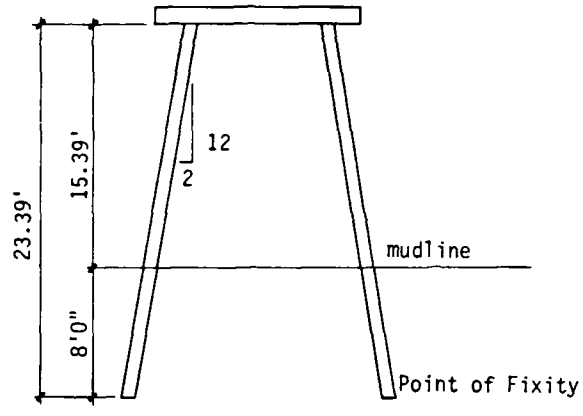
REINFORCEMENT

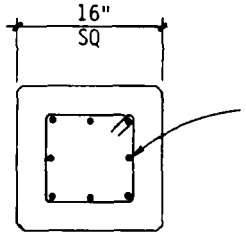
Assume 2% Ag

$A_s = 0.02(16)(16) = 5.12 \text{ in.}^2$

Use 8 # 7

$A_s = 8(0.60) = 4.80$





8 # 7 vert, Fy = 40 ksi

f'c = 4000 psi

```
**************************************************************************

        CALCULATE FRAME AXIAL FORCES AND MOMENTS FOR
        DEAD LOAD, LIVE LOAD, SEISMIC LOAD, AND DEAD
        PLUS LIVE PLUS SEISMIC LOADS; TO DETERMINE
        THE MAXIMUM ALLOWABLE LIVE LOAD CAPACITY OF
        THE PIER FOR THE PILE WITH THE AVERAGE STIFFNESS.

**************************************************************************

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*** SYSTEMS PROFESSIONAL STRESS - PROGRAM NO. 16.1 REV-2030.G1 ***

**************************************************************************

STRUCTURE - TYPICAL BENT - PIERS 1 THRU 15          (LATERAL DIRECTION)
TYPE PLANE FRAME
NUMB OF JOINTS 6 $ TRACE
NUMB OF MEMB 5 $ NUMB OF LOADS 6
NUMB OF SUPPORTS 2
TABU FORCES REACTIONS DISPLACEMENTS
UNITS KIPS FEET
JOINT COOR
1 0 0 S $ 2 4.07 24.39 $ 3 16.96 0 S
4 12.90 24.39 $ 5 2.07 24.39 F $ 6 14.90 24.39 F
UNITS KIPS INCHES
MEMB PROP PRIS AX 256.0 IZ 5461.0 $ 16 X 16 PILE
1$2
MEMB PROP PRIS AX 360.0 IZ 6750.0 $ BEAM CAP
3 THRU 5
MEMB INCI
1 1 2 $ 2 3 4 $ 3 2 4 $ 4 5 2 $ 5 4 6
CONST E 3644. ALL BUT 3122. 3,4,5
UNITS KIPS FEET
LOADING NO 1 - DEAD LOAD
MEMBER LOADS
3 FORCE Y UNIFORM -1.58
4 FORCE Y UNIFORM -3.54 $ 5
JOINT LOADS
2 FORCE Y -5.49 $ 4
LOADING NO 2 - LIVE LOAD
MEMBER LOADS
3 FORCE Y UNIFORM -6.00 $ 4 $ 5
LOADING NO 3 - SEISMIC LOAD
JOINT LOADS
2 FORCE X 4.67 $ 4
LOADING NO 4 - DEAD + LIVE
COMBINE 1 1.4 2 1.7
LOADING NO 5 - DEAD + SEISMIC
COMBINE 1 0.9 3 1.4
LOADING NO 6 - DEAD + LIVE + SEISMIC
COMBINE 1 1.05 2 1.28 3 1.40
SOLVE
PROBLEM CORRECTLY SPECIFIED. EXECUTION TO PROCEED.
```
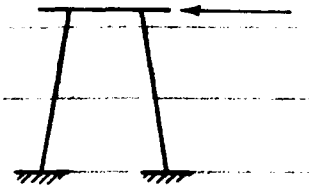



STRUCTURE - TYPICAL BENT - PIERS 1 THRU 15

(UNITS IN FEET AND KIPS)

LOADING NO 1 - DEAD LOAD

MEMBER FORCES

MEMBER	JOINT	AXIAL FORCE	SHEAR FORCE	MOMENT
1	1	19.819	-0.067	-0.50
	2	-19.819	0.067	-1.17
2	3	-19.835	0.073	0.56
	4	-19.835	-0.073	1.24
3	2	3.329	6.968	8.25
	4	-3.329	6.984	-2.32
4	5	0.000	-0.000	-0.00
	2	0.000	7.050	-7.08
5	4	0.000	7.050	7.08
	6	-0.000	0.000	-0.00

APPLIED JOINT LOADS, FREE JOINTS

JOINT	FORCE X	FORCE Y	MOMENT Z
2	0.000	-5.490	-0.00
4	0.000	-5.490	-0.00
5	0.000	-0.000	-0.00
6	-0.000	0.000	-0.00

REACTIONS,APPLIED LOADS SUPPORT JOINTS

JOINT	FORCE X	FORCE Y	MOMENT Z
1	3.329	19.538	-0.50
3	-3.329	19.553	0.56
SUM	-0.000	39.091	

FREE JOINT DISPLACEMENTS

JOINT	X-DISPLACEMENT	Y-DISPLACEMENT	ROTATION
2	0.0000	-0.0005	-0.0001
4	0.0000	-0.0005	0.0001
5	0.0000	-0.0005	-0.0000
6	0.0000	-0.0005	0.0000

STRUCTURE - TYPICAL BENT - PIERS 1 THRU 15

(UNITS IN FEET AND KIPS)

LOADING NO 2 - LIVE LOAD

MEMBER FORCES

MEMBER	JOINT	AXIAL FORCE	SHEAR FORCE	MOMENT
1	1	39.113	-0.639	-5.16
	2	-39.113	0.639	-10.64
2	3	39.143	0.649	5.28
	4	-39.143	-0.649	10.77
3	2	7.068	26.474	22.64
	4	-7.068	26.506	-22.77
4	5	0.000	0.000	0.00
	2	0.000	12.000	-12.00
5	4	0.000	12.000	12.00
	6	-0.000	-0.000	0.00

APPLIED JOINT LOADS - FREE JOINTS

JOINT	FORCE X	FORCE Y	MOMENT Z
2	3.000	0.000	-0.00
4	-0.000	0.000	-0.00
5	0.000	0.000	0.00
6	-0.000	-0.000	0.00

REACTIONS,APPLIED LOADS SUPPORT JOINTS

JOINT	FORCE X	FORCE Y	MOMENT Z
1	7.068	38.474	-5.16
3	-7.068	38.505	5.28
SUM	0.000	76.980	

FREE JOINT DISPLACEMENTS

JOINT	X-DISPLACEMENT	Y-DISPLACEMENT	ROTATION
2	0.0001	-0.0011	-0.0005
4	0.0000	-0.0011	0.0005
5	0.0001	-0.0002	-0.0004
6	0.0000	-0.0001	0.0004

STRUCTURE - TYPICAL BENT - PIERS 1 THRU 15

(UNITS IN FEET AND KIPS)

LOADING NO 3 - SEISMIC LOAD

MEMBER FORCES

MEMBER	JOINT	AXIAL FORCE	SHEAR FORCE	MOMENT
1	1	-9.825	3.097	36.05
	2	9.825	-3.097	40.53
2	3	9.824	3.098	36.05
	4	-9.824	-3.098	40.54
3	2	-0.001	-9.181	-40.53
	4	0.001	9.181	-40.54
4	5	0.000	-0.001	-0.00
	2	0.000	0.001	-0.00
5	4	-0.003	0.000	-0.00
	6	0.003	-0.000	0.00

APPLIED JOINT LOADS, FREE JOINTS

JOINT	FORCE X	FORCE Y	MOMENT Z
2	4.671	0.001	-0.00
4	4.667	-0.001	-0.00
5	0.000	-0.001	-0.00
6	0.003	-0.000	0.00

REACTIONS.APPLIED LOADS SUPPORT JOINTS

JOINT	FORCE X	FORCE Y	MOMENT Z
1	-4.672	-9.181	36.05
3	-4.669	9.182	36.05
SUM	-9.341	0.000	

FREE JOINT DISPLACEMENTS

JOINT	X-DISPLACEMENT	Y-DISPLACEMENT	ROTATION
2	0.0230	-0.0036	0.0004
4	0.0230	0.0036	0.0004
5	0.0230	-0.0044	0.0004
6	0.0230	0.0044	0.0004

STRUCTURE = TYPICAL BENT - PIERS 1 THRU 15

(UNITS IN FEET AND KIPS)

LOADING NO 4 - DEAD + LIVE

MEMBER FORCES

MEMBER	JOINT	AXIAL FORCE	SHEAR FORCE	MOMENT
1	1	94.238	-1.180	-9.47
	2	-94.238	1.180	-19.72
2	3	94.312	1.206	9.76
	4	-94.312	-1.206	20.05
3	2	16.675	54.762	50.03
	4	-16.675	54.836	-50.36
4	5	0.000	0.000	-0.00
	2	0.000	30.312	-30.31
5	4	0.000	30.312	30.31
	6	-0.000	0.000	-0.00

APPLIED JOINT LOADS, FREE JOINTS

JOINT	FORCE X	FORCE Y	MOMENT Z
2	0.000	-7.635	-0.00
4	-0.000	-7.686	-0.00
5	0.000	0.000	-0.00
6	-0.000	0.000	-0.00

REACTIONS,APPLIED LOADS SUPPORT JOINTS

JOINT	FORCE X	FORCE Y	MOMENT Z
1	16.675	92.759	-9.47
3	-16.675	92.834	9.76
SUM	0.000	185.593	

FREE JOINT DISPLACEMENTS

JOINT	X-DISPLACEMENT	Y-DISPLACEMENT	ROTATION
2	0.0002	-0.0026	-0.0009
4	0.0000	-0.0025	0.0009
5	0.0002	-0.0009	-0.0008
6	0.0000	-0.0009	0.0008

STRUCTURE - TYPICAL BENT - PIERS 1 THRU 15

(UNITS IN FEET AND KIPS)

LOADING NO 5 - DEAD + SEISMIC

MEMBER FORCES

MEMBER	JOINT	AXIAL FORCE	SHEAR FORCE	MOMENT
1	1	4.082	4.275	50.02
	2	-4.082	-4.275	35.70
2	3	31.604	4.402	50.98
	4	-31.604	-4.402	52.86
3	2	2.994	-6.582	-49.32
	4	-2.994	10.139	-54.27
4	5	0.000	-0.001	-0.00
	3	0.000	6.373	-6.37
5	4	-0.004	6.372	-6.37
	6	0.004	-0.000	0.00

APPLIED JOINT LOADS, FREE JOINTS

JOINT	FORCE X	FORCE Y	MOMENT Z
2	6.539	-4.940	-0.00
4	6.534	-4.942	-0.00
5	0.000	-0.001	-0.00
6	0.004	-0.000	0.00

REACTIONS, APPLIED LOADS SUPPORT JOINTS

JOINT	FORCE X	FORCE Y	MOMENT Z
1	-3.545	4.730	50.02
3	-9.532	30.453	-50.98
SUM	-13.077	35.183	

FREE JOINT DISPLACEMENTS

JOINT	X-DISPLACEMENT	Y-DISPLACEMENT	ROTATION
2	0.0322	-0.0055	0.0005
4	0.0322	-0.0045	0.0006
5	0.0322	-0.0065	0.0005
6	0.0322	0.0057	0.0006

STRUCTURE = TYPICAL BENT = PIERS 1 THRU 15

(UNITS IN FEET AND KIPS)

LOADING NO 6 - DEAD + LIVE + SEISMIC

MEMBER FORCES

MEMBER	JOINT	AXIAL FORCE	SHEAR FORCE	MOMENT
1	1	57.119	3.448	43.34
	2	-57.119	-3.448	41.91
2	3	84.683	5.244	57.82
	4	-84.683	-5.244	71.84
3	2	12.540	28.350	-19.11
	4	-12.540	54.113	-34.63
4	5	0.000	-0.001	-0.00
	2	0.000	22.795	-22.79
5	4	-0.004	22.794	22.79
	6	0.004	-0.000	0.00

APPLIED JOINT LOADS - FREE JOINTS

JOINT	FORCE X	FORCE Y	MOMENT Z
2	6.539	-3.763	-0.00
4	6.534	-5.765	-0.00
5	0.000	-0.001	-0.00
6	0.004	-0.000	0.00

REACTIONS.APPLIED LOADS SUPPORT JOINTS

JOINT	FORCE X	FORCE Y	MOMENT Z
1	6.001	56.908	43.34
3	-19.078	82.673	57.82
SUM	-13.077	139.580	

FREE JOINT DISPLACEMENTS

JOINT	X-DISPLACEMENT	Y-DISPLACEMENT	ROTATION
2	0.0323	-0.0069	-0.0001
4	0.0322	0.0031	0.0013
5	0.0323	-0.0068	-0.0000
6	0.0322	0.0054	0.0012

FOR COLUMN INTERACTION DIAGRAM
Mu = Mu/R = 71.84/0.70 = 102.6 FT-K
Pu = Pu/R = 84.68/0.70 = 121.0 K

INTERACTION DIAGRAM

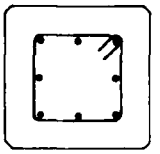
16" SQUARE CONCRETE PILE

8 #7 VERTICAL, 3" CLEAR

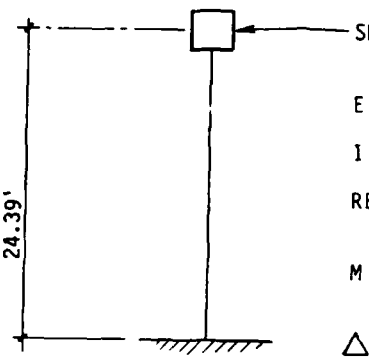
Fy = 40 KSI F'c = 4000 PSI

$Pu \geq \frac{U}{\phi}$ $Mu \geq \frac{U}{\phi}$

REF. ACI 318-83 9.2,9.3



LONGITUDINAL DIRECTION



SL = 9.34 k (Total load, both piles)

E = 3644 ksi

I = 2(5461) = 10922 $in.^4$

REF: AISC, 8th Edition
Pg 2-121, No. 23

$M = \frac{PL}{2} = \frac{9.34(24.39)}{2} = 113.9$ Ft-K

$\Delta = \frac{PL^3}{12EI} = \frac{9.34(24.39)^3(1728)}{12(3644)(10922)} = 0.49$ in.

LOADS

U = 0.75 (1.4D+1.7L+1.7(1.1)S)

= 1.05D+1.28L+1.40S

P_u = 1.05(19.84)+1.28(39.14) = 70.93k

M_x = 1.05(1.24)+1.28(10.77) = 15.08 ft-k

M_y = 1.40(113.9)(1/2)+9.34(0.49/12)(1/2) = 79.92 ft-k

BIAXIAL BENDING - Use PCA Load Contour Method

REF: Notes on ACI 318-83
Pg 11-8 C

P_d = 732.3 k

P_u = 70.93 k/0.70 = 101.33 k

From interaction diagram @ P_u = 101.33 k

$M_{d_x} = M_{d_y}$ = 107.0 ft-k

LONGITUDINAL DIRECTION (Cont.)

BIAXIAL BENDING (Cont.)

$$\frac{P_u}{P_d} = \frac{70.93}{732.3} = 0.097$$

$$W = \frac{P_g f_y}{f'c} = \frac{8(0.60)(40)}{16(16)(3)} = 0.250$$

From Fig. 11-16

$B = 0.675$

$$\left(\frac{M_{u_x}}{M_{d_x}}\right)^{\frac{\log 0.5}{\log B}} + \left(\frac{M_{u_y}}{M_{d_y}}\right)^{\frac{\log 0.5}{\log B}} \leq 1.0$$

$M_{u_x} = M_x/R = 15.08/0.70 = 21.54$

$M_{u_y} = M_y/R = 79.92/0.70 = 114.17$

$\log 0.5/\log 0.675 = 1.76$

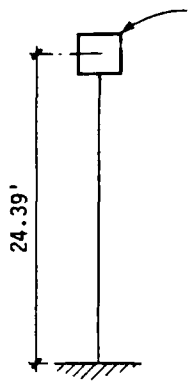
$$\left(\frac{21.54}{107.0}\right)^{1.76} + \left(\frac{114.17}{107.0}\right)^{1.76} = 1.18 \leq 1.0 \quad \text{NG}$$

With 400 psf live load plus dead load plus seismic load acting in the longitudinal direction of the pier, the concrete piles are overstressed by approximately 20%.

LONGITUDINAL DIRECTION

LL - 200 psf

SL - 0.16(39.0+0.2(12.83)(15)(25%)) = 7.78 kips



E = 3644 ksi

I = 2(5461) = 10922 in.^{4}

REF: AISC 8th Edition
Pg 2-21, No. 23

$$M = \frac{PL}{2} = \frac{7.78(24.39)}{2} = 94.9 \text{ ft-k}$$

$$\triangle = \frac{PL^3}{12EI} = \frac{7.78(24.39)}{12(3644)(10922)} = 0.41 \text{ in.}$$

LOADS

U = 0.75(1.4D+1.7L+1.7(1.1)S)

= 1.05D+1.28L+1.1.40S

P_u = 1.05(19.84)+1.28(19.57) = 45.88 k

M_x = 1.05(1.24)+1.28(5.39) = 8.20 ft-k

M_y = 1.40(94.9)(1/2)+45.88(0.41/12)(1/2) = 67.21 ft-k

BIAXIAL BENDING - Use PCA Load Contour Method

Ref: Notes on ACI 318-83
Pg 11-8 C

P_d = 732.3 k

P_u = 45.88 k/0.70 = 65.5 k

From interaction diagram @ P_u = 65.5 k

$M_{d_x} = M_{d_y}$ = 98 ft-k

LONGITUDINAL DIRECTION (Cont.)

BIAXIAL BENDING (Cont.)

$$\frac{P_u}{P_d} = \frac{45.88}{732.3} = 0.06$$

$$W = \frac{pfy}{f'c} = \frac{8(0.60)(40)}{16(16)(3)} = 0.25$$

From Fig. 11-16

B = 0.71

$$\left(\frac{M_{u_x}}{M_{d_x}}\right)^{\frac{\log 0.5}{\log B}} + \left(\frac{M_{u_y}}{M_{d_y}}\right)^{\frac{\log 0.5}{\log B}} \leq 1.0$$

$M_{ux} = M_x/R = 8.20/0.71 = 11.6$ ft.-k

$M_{uy} = M_y/R = 67.21/0.71 = 94.7$ ft.-k

$$\left(\frac{11.6}{98}\right)^{2.02} + \left(\frac{94.7}{98}\right)^{2.02} = 0.95$$

Maximum Live Load - Longitudinal Direction

LL max = 200 psf

```
*** S STEPS PROFESSIONAL PROGRAM NO. 11.0  REV-[illegible] ***
    CONCRETE COLUMN - STRENGTH DESIGN METHOD  1977 ACI
**************************************************************************

[illegible] INSPECTION [illegible] BASE
[illegible]

16" SQUARE CONCRETE PILE WITH 8 #7 VERTICAL
F'C = 4000 PSI , FY = 40 KSI , 3" CLEAR - TYPICAL

**************************************************************************
ALL INFORMATION PRESENTED IS FOR REVIEW, APPROVAL, INTERPRETATION
AND APPLICATION BY A REGISTERED ENGINEER
**************************************************************************

[illegible]

INPUT VALUES
----------------------------
B     T     F'C  FY   PHIC PHIB ASMIN ASMAX  CLRMN F'C   EC       ES    EU
IN    IN    KSI  KSI             SQ-IN SQ-IN  IN    KSI   KSI      KSI   IN/IN
[illegible]

                      MIN ROW 1+2  MAX ROW 1+2  MIN ROW 3+4  MAX ROW 3+4
R     NO. BAR COV  NO. BAR COV  NO. BAR COV  NO. BAR COV  NO. BAR COV
MODE BAR SIZE IN   BAR SIZE IN  BAR SIZE IN  BAR SIZE IN  BAR SIZE IN
[illegible]

NO. OF   BAR    AREA OF          STEEL        COVER
BARS     SIZE   STEEL (SQ-IN)    PERCENTAGE   (IN)
  8       7       4.80             1.88        3.00

[illegible]

           ROW 1        ROW 2        ROW 3        ROW 4

BARS      ? NO. 7      3 NO. 7      1 NO. 7      1 NO. 7
COVER      3.000        3.000        3.000        3 000

          NO                  INTERACTION INFORMATION
          OF LOADING          0=NOT REQUESTED, OTHERWISE REQUESTED
LMODE   LINES                 X AXIS(IDX)  Y AXIS(IDY)
  0       0                      1            1

VALUES ASSUMED BY PROGRAM
----------------------------
B     T     F'C  FY   PHIC PHIB ASMIN ASMAX CLRMN F'C   EC     ES      EU
IN    IN    KSI  KSI             SQ-IN SQ-IN IN    KSI   KSI    KSI     IN/IN
16.0 16.0  4.0  40.  0.70 0.90  0.00  0.00  0.00  3.    3605   29000.  0.003

                      MIN ROW 1+2  MAX ROW 1+2  MIN ROW 3+4  MAX ROW 3+4
R     NO. BAR COV  NO. BAR COV  NO. BAR COV  NO. BAR COV  NO. BAR COV
MODE BAR SIZE IN   BAR SIZE IN  BAR SIZE IN  BAR SIZE IN  BAR SIZE IN
 1     2   7  3.00  2   7  3.00  3   7  3.00  1   7  3.00  1   7  3.00
```

INTERACTION CONTROL POINTS REQUESTED

	PZ	PB	MB	IPS	IM	MZ
X -AXIS	732.3	259.3	133.4	102.7	107.4	87.5
Y -AXIS	732.3	259.3	133.4	102.7	107.4	97.5
Z -AXIS	732.3	279.9	112.4	102.4	93.3	91.0

INTERACTION DIAGRAM

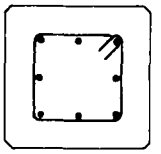
16" SQUARE CONCRETE PILE

8 #7 VERTICAL, 3" CLEAR

Fy = 40 KSI F'c = 4000 PSI

$Pu \geq \frac{U}{\phi}$ $Mu \geq \frac{U}{\phi}$

REF. ACI 318-83 9.2,9.3



5.4 BIBLIOGRAPHY

BIBLIOGRAPHY

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